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The Engineer

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PUBLIC NOTICES

WIRING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 5th January, 1928, for RE-WIRING WORK (in Steel Conduit) at the Ministry of Pensions Hospital, Orpington, Kent.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W.1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7249

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. About 110 TONS of STEEL FISH-BOLTS and NUTS.
2. CRANES for 5ft. 6in. Gauge :— PORTABLE STEAM, TWO 5 Tons.
3. STEAM TRAVELLING, TWO 7 Tons, ONE 10 Tons, FIVE 20 Tons, and ONE 35 Tons.
4. TWO MACHINES, DUPLEX BORING and TURNING, 30in., Motor Driven.
5. TWO BOILERS, Straight Water-tube Type, Stokers, Economisers, Chimney, &c.
6. TWO 300 K.W. HIGH-SPEED VERTICAL STEAM GENERATOR SETS and CONDENSING PLANT.
7. ONE H.T. CUBICLE SWITCHBOARD, ONE L.T. FLAT-BACK A.C. SWITCHBOARD.
8. TWO 200 K.V.A. TRANSFORMERS.

Tenders due on the 3rd January, 1928, for No. 1, on the 6th January, 1928, for No. 2, on the 10th January, 1928, for Nos. 3 and 4, and on the 13th January, 1928, for Nos. 5 to 8.

Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 7259

Ministry of Transport.
ARTERIAL ROADS—GREATER LONDON.
HASTINGS ROAD, KENT.

The Minister is prepared to receive TENDERS for COMPLETION and CONSTRUCTION WORKS on the CARRIAGEWAY and FOOTWAY and for WORKS of SURFACE WATER DRAINAGE, &c., of the Hastings Road, Kent, from Green Street Green to Pratts Bottom.

Form of Tender, conditions of Tender, conditions of contract, bill of quantities and specification may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, upon payment of a deposit of £25. This amount will be returned to the tenderer if his Tender is a bona fide one, and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

The drawings may be inspected at the offices of the Ministry, and copies of the Tender documents will be available on and after Wednesday, 14th December, 1927.

Tenders on the official form, each accompanied by a fully priced bill of quantities, must be enclosed in sealed envelopes, marked "Tender for Hastings Road Construction," and submitted to the undersigned on or before 10 a.m. on Monday, the 2nd day of January, 1928.

The Minister does not bind himself to accept the lowest or any Tender.

Dated this Third day of December, 1927.
(Sgd.) H. H. PIGGOT,
Assistant Secretary.
Ministry of Transport. 7186

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience, and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 7152

Indian Service of ENGINEERS.

The Secretary of State for India in Council will, in 1928, APPOINT NINE ASSISTANT EXECUTIVE ENGINEERS for this Service, including, if possible, ONE BURMAN, who will be appointed to the India recruit branch in Burma. Except for this one appointment, every candidate must be a European British subject of non-Asiatic domicile.

Candidates must have attained the age of 21 years and must not have attained the age of 24 years on 1st January, 1928.

They must either (1) have obtained one of certain recognised University Degrees or other distinctions in engineering, or (2) have passed the Final Examination of the Associate Membership Examination of the Institution of Civil Engineers or been exempted by the Institution from such examination, or (3) have passed the Associateship in Civil Engineering of the City and Guilds Institute (Imperial College of Science and Technology, South Kensington), or (4) produce the required evidence that they are otherwise eligible under the Regulations. They must in addition have had at least one full year's practical experience of Civil Engineering under a qualified Civil Engineer.

Applications from candidates must reach the India Office not later than 1st April, 1928. Printed forms, together with information regarding the conditions of appointment, may be obtained from the SECRETARY, Services and General Department, India Office, Whitehall, S.W. 1. 7223

PUBLIC NOTICES

Assistant Engineers (5) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £80 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 35 years of age, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. Must have had proper technical training and preferably have had not less than two years' subsequent experience on large engineering or municipal works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/254. 7172

Civil Engineer Required for a Bridge Contract on the NIGERIAN GOVERNMENT RAILWAY, for two tours of from 12 to 18 months' service, with possible extension. Commencing salary £720 to £800 a year, according to qualifications, rising by annual increments of £40 to £920 a year, plus duty pay at the rate of £72 a year. Commuted bush, travelling and detention allowance of £9 a month payable. Free passages and camp equipment provided, liberal leave on full salary. Candidates, aged 30-40, must have had experience of Heavy Masonry Foundations, Compressed Air and Brickwork generally, also Hydrographical Surveys.—Apply at once by letter, stating age and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/350. 7258

Crystal Palace School of Practical ENGINEERING.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 6642

PUBLIC NOTICES

Great Southern Railways (IRELAND).
RAILWAY MATERIAL.

The Directors of the Great Southern Railways (Ireland) are prepared to receive TENDERS for the SUPPLY of the following :—
2000 TONS STEEL B.H. RAILS, 90R. Section.
60 TONS STEEL FISH-PLATES for DITTO.
5200 TONS STEEL F.B. RAILS, 85 lb.
135 TONS STEEL FISH-PLATES for DITTO.
1700 TONS CAST IRON CHAIRS.
1200 TONS CAST IRON SOLE PLATES.

Specifications with Tender forms (on which alone offers will be considered) can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of Two Shillings and Sixpence for each Tender form.

Tenders should be forwarded in the envelopes provided for the purpose so as to be received by the undersigned not later than 5 p.m. on the following dates :—
For the Rails and Fishplates, Monday, 2nd Jan., 1928.
For the Chairs and Sole Plates, Wednesday, 28th Dec., 1927.
The lowest or any Tender will not necessarily be accepted.

C. E. RILEY,
Secretary.
Kingsbridge Station, Dublin,
December, 1927. 7208

The South Indian Railway COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—
HAND POWER RAM PUMPS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked :—Tender for "Hand Power Ram Pumps," must be left with the undersigned not later than 12 Noon on Friday, the 6th January, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

Copies of the drawings may be obtained from the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-Street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1,
16th December, 1927. 7261

PUBLIC NOTICES

Armstrong College, NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
7059 Newcastle-upon-Tyne.

Administrative County of LONDON.

The London County Council invites TENDERS for the CONSTRUCTION of an EMBANKMENT and RIVER WALL, about 565ft. in length, in the Thames in front of Grosvenor-road on the upstream side of Lambeth Bridge.

The specification, form of Tender, drawings, &c., may be obtained, on or after Tuesday, 20th December, 1927, on application to the Chief Engineer, upon payment of the sum of £5 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained upon personal application and the contract documents may be inspected before the payment of the fee.

Correspondence and remittances by post should be addressed to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, or, if personal application is made, applicants should apply in Room 3a at No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 23rd January, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
7248 Clerk of the London County Council.

Metropolitan Water Board.
TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY AT THE DEPTFORD PUMPING STATION, BROOKMILL-ROAD, DEPTFORD, LONDON, S.E. 8.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of ONE TRIPLE-EXPANSION ENGINE with RECIPROCATING PUMPS, THREE STEAM TURBINES with CENTRIFUGAL PUMPS, and ONE WATER-DRIVEN TURBINE with CENTRIFUGAL PUMP, at their Deptford Pumping Station, Brookmill-road, Deptford, London, S.E. 8.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 12th December, 1927.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Three Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board and endorsed "Tender for Machinery, Deptford," must be delivered at the Offices of the Board (Room 122) not later than 10 a.m. on Tuesday, 7th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
2nd December, 1927. 7201

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PUBLIC NOTICES

City of Liverpool.
JUNIOR MECHANICAL ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POSITION of JUNIOR MECHANICAL ENGINEERING ASSISTANT in the City Engineer's Department, at a commencing salary of £230 per annum, increasing by £15 per annum to £260 per annum (Division "A").

Applicants should be not less than 25 years of age and should have good general mechanical engineering experience and be neat and accurate draughtsmen, capable of making working drawings.

The successful candidate will be required to devote his whole time to the service of the Corporation and will be subject to the provisions of the Corporation's Superannuation Scheme, and to one month's notice on either side.

Applications, stating age, qualifications and experience, accompanied by copies of not more than three recent testimonials, endorsed "Junior Mechanical Engineering Assistant," to be delivered to Mr. T. Peirson Frank, M. Inst. C.E., City Engineer, Municipal Buildings, Liverpool, not later than 10 a.m. on Saturday, 31st December, 1927.

Canvassing, directly or indirectly, will be considered a disqualification.

WALTER MOON,
Town Clerk.

Municipal Buildings, Liverpool,
9th December, 1927. 7226

Egyptian State Railways,
TELEGRAPHS and TELEPHONES, REQUIRE the SERVICES of a SIGNAL INSPECTOR for the ENGINEERING DEPARTMENT at a salary of £E720 per annum, for a period of two years (£E1 equals £81 0s. 6d.).

QUALIFICATIONS REQUIRED :—

Specialised in Electro-pneumatic Signalling.

He would be required for the fitting in of the new installations of Electro-pneumatic Working of Points and Signals at Cairo Station, and it is absolutely essential that he has had actual practical experience in the following :—

Three-phase Electrical-driven Air Compressors (Alley and MacLellan type).
C Type Magnets for Point Operation.
Daylight Signals.
A.C. Track Circuits.
Illuminated Diagrams.
Electrical Detection of Points and Signals.
Relays.
Wiring Diagrams.
Fitting up the various types of Points Lay-outs.

If possible, the candidate should be a B.Sc. and an A.M.I.S.E.

Application form can be obtained from—
THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1.

Forms must be forwarded to him marked "SIGNAL INSPECTOR." 7179

Required for Service on the
EAST INDIAN RAILWAY (Indian State Railways) :—

ONE ERECTING SHOP FOREMAN. Candidates must have been trained in the underframe shops of a British Railway Company, or with a Carriage and Wagon Builder of repute, and possess a specialised knowledge of the latest mass production methods employed in the construction of carriage underframes. Age between 25 and 30 years.

ONE SMITH SHOP FOREMAN. Candidates must have been trained in the works of a large British Engineering Establishment and possess a specialised knowledge of the latest methods of forging and press work on a large scale. Experience in a Carriage and Wagon Shop is not essential, but preference would be given to one having practical experience of works where mass production of underframes and carriage ironwork has been carried out. Age between 25 and 30 years.

SALARY (for both appointments).—Rupees 575, rising by annual increments of Rs. 25 to Rs. 650 per calendar month.

TERMS.—Five years' agreement in the first instance, with a free second-class passage to India and return passage on satisfactory termination of services. Selected candidates will only be appointed subject to satisfactory references and a strict medical examination.

Applicants should give full details of their education and career to date, showing where apprenticeship was served and subsequent experience, particularly of the departments in which employed, the machines on which they have actually worked, details of the work turned out, and whether used to electric or steam-driven plant, and hydraulic or other presses.—Applications (accompanied by COPIES ONLY of testimonials) should be addressed to the undersigned not later than 29th December, 1927.

RENDEL, PALMER and TRITTON,
12-14, Dartmouth-street,
7230 Westminster, London, S.W. 1.

Contractors Wishing to
TENDER for the RECONSTRUCTION of 135 LINEAL YARDS of SALTBURN PIER please communicate at once with the OWNERS of the MIDDLESBROUGH ESTATE, Ltd., Queen's-square, Middlesbrough. P3994

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

PLEASE NOTE that the POST ADVERTISED in our issue of December 2nd, under Box 7109, HAS BEEN FILLED 6263 A.

WANTED, ENGINE WORKS MANAGER, by East Coast Scotland Firm of Marine Engineers and Shipbuilders; must be a good organiser, accustomed to control men; Foundry and Diesel Experience would be an advantage. Essential to have had experience in similar capacity. State age, and salary expected.—Address, 7217, The Engineer Office. 7217 A

WANTED, First-class FURNACE ENGINEERING SALESMEN and DESIGNING DRAUGHTSMEN. Only those fully conversant with latest Furnace Engineering Practice need apply. Good positions open for right men. Replies treated in strict confidence.—Address, 7219, The Engineer Office. 7219 A

WANTED for Mines in Malaya, ELECTRICAL ENGINEER, experienced in the Running of Steam Generating Plants and Maintenance of large Motors and Electrical Equipment; preferably one with experience in Cement Plants or similar undertakings. First-class men only need apply. Must be Associate Member Institution of Electrical Engineers.—Reply by letter to FRANCIS CHAPMAN, SONS and DEEKES, Ltd., Australia House, Strand, giving full particulars and salary required. P3999 A

WANTED, MECHANICAL ENGINEER for Small Waterworks Pumping Station. Must have had experience of Two-stroke Oil Engines, Gas Engines, and Suction Gas Plants and be fully capable of keeping same in running order and doing overhaul repairs. House provided. State wage required, age, and experience to JERSEY NEW WATERWORKS COMPANY, 2, Mulcaster-street, Jersey, Channel Islands. P3998 A

WANTED, Thoroughly Experienced TRADE MARK AGENT or BARRISTER familiar with British and Foreign Trade Marks for International Corporation in America. Substantial salary.—Address full particulars, age and experience, to P3997, The Engineer Office. P3997 A

AN ASSISTANT SUPERINTENDENT ENGINEER. Must hold Chief Engineer's Certificate (Board of Trade); must have good experience of Hull and Machinery Repairs, and knowledge of values and have held an executive position; age 28-36. State salary required.—Apply by letter, briefly stating experiences and present position, to WATTS, WATTS and CO., Ltd., 7, Whittington-avenue, Leadenhall-street, London, E.C. 3. 7255 A

ASSISTANT to MANAGING DIRECTOR REQUIRED for large Automobile Factory in Midlands. Sound commercial and technical experience essential.—Address, stating experience and salary required, 7218, The Engineer Office. 7218 A

DIEMAKER.—Expert on Making Large Dies, capable of setting Piece Rates for all operations in tool-room and following work through. Reply stating fullest experience. Only first-class men need apply. Good prospects.—Address, 7220, The Engineer Office. 7220 A

ENGINEER SALESMAN REQUIRED, Resident London, for Centrifugal Oil Purifiers, &c.; must be expert salesman and organiser and technical knowledge essential. Salary and commission, with prospects —Address, P3990, The Engineer Office. P3990 A

EXPERIENCED MECHANICAL DRAUGHTSMAN REQUIRED with good knowledge of Elevating and Conveying Plant, for works in London area.—Address, stating age, experience in detail, and salary required, 7241, The Engineer Office. 7241 A

EXPERIENCED TOOL DESIGNER WANTED in London Works; conversant with latest Machine Shop High Production Methods for small and medium work.—Address, stating age, salary required, and full details of experience, &c., 7229, The Engineer Office. 7229 A

OLD-ESTABLISHED FIRM of MECHANICAL ENGINEERS in India REQUIRE a trained ENGINEER SALESMAN. Good prospects. Age not over 24, unmarried; good education and address and experienced in Oil Engines and General Machinery.—Reply, giving fullest details education, engineering experience, present work and salary, to "Z X. 721," c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 7257 A

REQUIRED for Period Abroad, Fully Qualified ERECTING ENGINEER, conversant with all Meat Works Plant; speak Spanish.—Address, with full details, experience, salary, 7234, The Engineer Office. 7234 A

SALESMAN, with Connection in Engineering Small Tools, to call on firms in London district. Experience, age, and salary required.—Address, P3965, The Engineer Office. P3965 A

WANTED, DRAUGHTSMAN for Consulting Engineers' Office, London; used to preparing Layouts of Electric Power-houses and General Power Work to do with Industrial undertakings. Applicants to state age and experience. No original certificates or testimonials to be forwarded.—Address, 7233, The Engineer Office. 7233 A

WANTED, DRAUGHTSMAN, One Versed in Strength of Materials.—Address, 7238, The Engineer Office. 7238 A

WANTED, DRAUGHTSMAN, with First-class knowledge of Chemical and By-product Recovery Installations; also Gas Works Plant. State age and salary required.—Address, 7228, The Engineer Office. 7228 A

DRAUGHTSMAN and CHAUFFEUR, Single Young man, accustomed Conveying Schemes preferred. Must look after car and be good driver; take advertiser on journeys whenever required.—Address, 7256, The Engineer Office. 7256 A

DRAUGHTSMAN. — Experienced ENGINEERING DRAUGHTSMAN REQUIRED, with thorough knowledge of Structures and used to Mechanical Work. —Apply, stating age, experience, and salary required, FRASER and CHALMERS ENGINEERING WORKS, Erith, Kent. 7250 A

DRAUGHTSMAN, First-class Mechanical, Having sound experience of Linotype or Automatic Machine Design, together with Jig and Tool experience.—Address, giving particulars of age, experience, and salary required, 7183, The Engineer Office. 7183 A

DRAUGHTSMAN WANTED, Midlands, Accustomed to Design Stone-breaking and Screening Plant Details; quick and accurate. State age, experience and salary expected.—Address, 7216, The Engineer Office. 7216 A

MECHANICAL DRAUGHTSMAN REQUIRED, good general experience, London district.—Address, stating age, full experience, and salary required, 7240, The Engineer Office. 7240 A

MECHANICAL DRAUGHTSMAN, with Boiler Plant experience. State age, salary, and experience.—Address, 7236, The Engineer Office. 7236 A

REQUIRED, First-class DESIGNER for Heavy Mechanical and Gear Details, with experience of inspection work. Must have had good shop experience. State age, experience, and salary required.—Address, 7252, The Engineer Office. 7252 A

REQUIRED, SEVERAL FIRST-CLASS AERONAUTICAL DRAUGHTSMEN. State age, experience, and salary required.—Address, giving full particulars, 7239, The Engineer Office. 7239 A

TWO JUNIOR DRAUGHTSMEN, Thoroughly Experienced in Overhead Electric Cranes, WANTED in East Midlands; also ONE for Conveyor and Elevator Work. State age, experience, and wages required.—Address, 7235, The Engineer Office. 7235 A

SITUATIONS WANTED

ENGINEER, 1st Class Draughtsman and Translator (English, young); fluent technical French, 5 years' experience Continent, mechanical and structural engineering.—"B.," 3, Westgate-road, Beckenham. 7138 B

ENGINEER (44) COAL and OIL EXPERT, M.I. Mech. E., M.I. Mar. E., M. Inst. Fuel, 1st Cl. B.O.T. Cert. (11 yrs. Chief), Ex.-Engr.-Lieut., R.N.R., author oil-burning textbook, contrib. Tech. Press, practical experience in boilers, mechanical stokers, superheat, coal suction plants, deep well pumps, gas and oil engines, lay-out and maintenance industrial plants, used to administrative positions, both office and works, SEEKS RESPONSIBLE POSITION.—Address, P4004, The Engineer Office. P4004 B

EXPERIENCED ENGINEER SALESMAN (28) WISHES to HEAR from MANUFACTURERS desirous of EXTENDING their BUSINESS in London area. Salary, expenses and commission or commission only.—Address, P4007, The Engineer Office. P4007 B

WORKS ACCOUNTANT and ORGANISER DESIRES ADMINISTRATIVE POST. Expert in factory and workshop management, costs, estimates, experienced in general agricultural motor and electrical branches; large works preferred, but not essential.—Address, P4003, The Engineer Office. P4003 B

DRAUGHTSMAN, at Present Finishing His Time in Baghdad, would LIKE a POSITION in England, about April or May. Broad experience, age 32.—Address, P3969, The Engineer Office. P3969 B

AGENCIES

A M.I. MECH. E., with Established Connection amongst colliery and works engineers, SEEKS AGENCY for South Yorkshire, Derbyshire, &c. Own car.—Address, P3995, The Engineer Office. P3995 D

FIRM of ENGINEERS, Newcastle, Good Connection with engineering firms and superintendent engineers in that district, are OPEN to ACT as REPRESENTATIVES to First-class British or Continental Firms.—Address, 4000, The Engineer Office. 4000 D

NOTICE.—Old-established FIRM of BREWERS' ENGINEERS and COPPERSMITHS REQUIRE ENGINEER REPRESENTATIVES to undertake commission agencies in various parts of the country. —Address, stating age, experience, and terms required, P4005, The Engineer Office. P4005 D

MACHINERY, &c., WANTED

WANTED, Blake or Cochran Type BOILER for waste heat and auxiliary hand firing, 14 to 16 N.H.P., 160/80 lb. W.P.—Send full particulars THE CORNWALL BOILER CO., Ltd., Camborne. 7254 F

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 75 years.

If you wish to purchase or sell a Business connected with the Engineering or allied Industries consult:
HENRY BUTCHER, HALL & CO.,
63 & 64, CHANCERY LANE,
LONDON, W.C. 2.

PARTNERSHIP OFFERED to Engineer with speciality to manufacture. Capital unessential.—Address, P3991, The Engineer Office. P3991 C

£200 OFFERED for PARTNERSHIP in Small Engineering Works doing general engineering repairs, with good electrical connection; North Midland area.—T. ROPER and CO., Accountants, Bromsgrove. P3988 C

EDUCATIONAL

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For continuation of Small Advertisements see page 3.

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A Seven-Day Journal

The Central Scotland Electricity Scheme.

IT was announced this week that the Central Electricity Board had awarded to British Insulated Cables, Ltd., of Prescot, Lancs., an order for approximately 228 route miles of 132,000-volt three-phase overhead transmission lines for use in Scotland. The materials are to be supplied from within the British Empire and will include about 1000 miles of steel-cored aluminium conductors and 1500 steel towers. The value of the order is approximately £400,000, and it is said to be the largest single order for such work ever placed in this country. Some details of the Central Scotland electricity scheme were given in our issue of May 13th, 1927. The stations selected for interconnection under the scheme involved, it was stated, the running of lines, each capable of transmitting not less than 50,000 kW, between (*a*) Clyde's Mill and Yoker, (*b*) Portobello and Dalmarnock, (*c*) Portobello and Clyde's Mill, (*d*) Dalmarnock and Greenock, (*e*) Dunfermline and Dundee, and (*f*) Yoker and Greenock. The estimated dates for the completion of these lines were October 31st, 1928, 1929, 1930, 1931, 1931, and 1932 respectively. The cost of the primary transmission system and the transformer stations required in connection with it was estimated at £2,204,034, to which was to be added a sum of £2,921,250 representing the cost of standardising the frequency of the interconnected power plants.

Yarrow and Co., Ltd.

ON Monday last, December 12th, Mr. Harold Yarrow, when presiding over the sixth annual meeting of Yarrow and Co., Ltd., made reference to the resignation of Sir Alfred Yarrow from the position of president of the company. He said that during the sixty and more years which Sir Alfred had given to the building up of the high reputation which the firm now enjoyed the shipbuilding and engineering professions had reaped much benefit from his work. Although Sir Alfred had resigned, his advice would still be available to the company. Brief reference was made to the success of H.M.S. Ambuscade, which, along with the Thornycroft-built destroyer Amazon, represents the latest development in destroyer practice. Of the four river gunboats which Yarrow and Co., Ltd., are constructing for the Admiralty, two have been delivered and two will shortly undergo their trials. The Dutch Government, Mr. Yarrow stated, had decided to lay down two further destroyers of Yarrow design, making eight in all. One destroyer built in Holland with the firm's technical assistance had recently run a series of satisfactory trials. Although work was required for both the shipbuilding yard and the engine shops, the boiler department was busy and would remain so for some months to come. Among the more interesting contracts which had been secured by the firm were the boilers for the new P. and O. liner and some 600 lb. pressure boilers for power station work. During the year the company had made arrangements with certain firms at home and abroad to construct Yarrow boilers to its designs. In spite of keen competition and low prices, the year had been a successful one and a profit had again been made.

A Veteran Engineer.

IN company with all engineers we congratulate Professor W. Cawthorne Unwin on entering on Monday, December 12th, his ninetieth year. Dr. Unwin is, of course, best known as the quondam Dean and Professor of Engineering at the Central Technical College, Kensington, where he served for a period of twenty years. He was born at Coggleshall, Essex, and was educated at the City of London School. He started practical life as a pupil in the firm of William Fairbairn, Manchester. After being manager of some engineering works he began his teaching career as instructor in the Royal School of Naval Architecture and Marine Engineering, South Kensington. Next he became Professor of Hydraulic Engineering at the Royal Indian Engineering College, Cooper's Hill, and then went to the Central Technical College. Since retiring, about twenty-seven years ago, he has practised as a consulting engineer and has kept in touch with modern developments.

Steel Pit Props.

IN his annual report for 1926, published in September, his Majesty's Chief Inspector of Mines expressed himself in distinctly forcible terms regarding the use of steel arches and steel props in mines. He claimed that both safety and economy were enhanced by the use of such supports, but suggested that their adoption was being hampered by a lack of initiative among agents and managers or by unwillingness on the part of owners to meet the cost. That cost, he said, was greater than the cost of timber supports in the first instance, but would be repaid many times over in the course of a year or two. He urged that actual trials of steel supports should be undertaken by every mine in the country, and that the results obtained should not be kept secret, but should be disseminated for the benefit of all concerned. The British Colliery Owners' Research Association has apparently taken the Inspector's words to heart. It was announced this week that the Association has decided to appoint a qualified mining engineer to conduct a technical investigation into the use of steel supports in place of timber underground. It is realised that the use of steel supports on a large scale would greatly benefit the steel industry, and to a corresponding extent would benefit the coal industry itself by increasing the steel works demand for coal. In some cases the difficulties encountered in the use of steel props have necessitated a reversion to timber, but the Association hopes that with the extended knowledge set free by its investigator's work it will be possible to secure a much wider use of steel supports than at present prevails.

The March Goods Junction Scheme.

DURING the course of last week Sir Ralph Wedgwood, the chief general manager of the London and North-Eastern Railway, gave some particulars of the new goods junction and train marshalling yard which is to be constructed at March, near Cambridge, at an estimated cost of about £300,000. The principal feature of interest in the new installation will be the use of four hydraulically operated retarders, which have been adopted after studying the latest shunting practice both in America and Germany. In the finished scheme ten reception sidings are provided for, each of which will accommodate a train of eighty wagons, besides which there will be forty marshalling sidings capable of holding 3679 wagons. The adoption of retarders will supersede the "hump" shunting system, and the retarders will be worked by hydraulic power from an elevated cabin, so that any desired braking power can be applied as the wagon passes over the machine. It is anticipated that the new device will enable work to be done in eight minutes which is now done in fifteen. It is also claimed that there will be less breakage of goods and smaller wear and tear on wagon stock, while much safer working will be introduced, as no hand braking by the brake stick will be required. Special flood lights are to be installed for night working, and it is hoped that the new yard will be completed in time to deal with full traffic towards the end of next year.

The Panama Canal Traffic.

IN the annual report of the Secretary of War for the United States, dealing with the Panama Canal, it is stated that the traffic through the canal was greater during last year than in any preceding year. British tonnage comprised about 25 per cent. of the total, and about 55 per cent. was American tonnage. Reference is made in the report to a scheme for supplying additional storage water, which, it is said, should be put in hand immediately. It is proposed to construct a dam across the river Chagres at Alhajuela, some 12 miles above the entrance of this river into the canal. By creating at this point an artificial lake 20 miles in area a capacity of 20,000 million cubic feet of water would be created, or nearly two-thirds the storage water which is now available. The additional water thus made available would suffice to provide for further lockages amounting to 100 million tons, or about four times the present traffic through the canal. A further advantage would be the deepening of the Gaillard Cut in the dry seasons, which would speed up the traffic and reduce the possibility of accidents. The scheme outlined would occupy six years to complete and would cost over two million pounds. The total tonnage handled by the canal during the past year was 26,227,815 tons, as against 24,774,591 tons the preceding year, with a corresponding increase in revenue.

A Suggested Clyde Shipbuilding Combine.

THE suggestion recently put forward by the Duke of Montrose, that there should be some kind of an understanding between Scottish shipbuilding interests, was referred to in a Journal note in our issue of December 2nd. In the course of a speech made at the launch of the motor vessel Taranaki, on Saturday last, December 10th, Sir Alexander Kennedy, the chairman and managing director of the Fairfield Shipbuilding and Engineering Company, Ltd., made some interesting observations on the proposal. It had to be borne in mind, he said, that many shipbuilding firms had been formed on a basis of warship construction as well as the building of merchant ships. To-day private firms were finding themselves burdened with equipment and resources which would probably meet naval requirements beyond any likely programme of construction, while any scrapping of such equipment would be of serious import to the country. Yet the deadweight burden was a very serious matter indeed to their industry. It would be generally agreed that such resources should be preserved, but firms were differently placed with regard to this matter, and each case must be dealt with according to its own merits. Sir Alexander, while agreeing that wise and economic combinations might be made in certain directions, did not see any basis for a general amalgamation. Shipbuilding, he went on to say, had always been an individualistic industry, and if personality was done away with the relation, between a firm and its *clientèle* would lose a genuine practical and economic value. On Monday last, in the *Glasgow Herald*, Lord Maclay gave expression to very similar views, and pointed out that while some of the great combines had suffered, certain private shipbuilding businesses not too large for personal control had continued to prosper more or less, even in the recent difficult times. Many people, he said, were of the opinion that Scotland was suffering severely from combines and trusts, and the present position of Scottish banks and railway undertakings was cited in support of the view that large amalgamations had not brought help to the Clyde.

American Naval Policy.

PROBLEMS of naval defence have been agitating American public opinion during the present week. It was reported on Tuesday that the President had given his approval to a programme of new construction embracing twenty-six cruisers of the 10,000-ton type, three aircraft carriers, five submarine cruisers, and eighteen flotilla leaders, the total cost being estimated at £80,000,000; and, further that authorisation had been granted for the building, in 1931–32, of four new battleships to replace ships that would become due for scrapping under the Washington Treaty. This report has since been disavowed at the White House, and it is officially stated that no definite shipbuilding plan has been agreed upon up to the present. On the other hand, Press messages from Washington indicate that a large programme of cruiser construction is impending. The House of Representatives has already voted £188,000 for reconstructing the battleships Oklahoma and Nevada, including an increase in the elevation of their turret guns. While the Senate is expected to ratify this measure, the final decision will rest with the President. The question of gun elevation first came to the fore in 1923, when Congress, having been informed by its naval advisers that Great Britain had modified the gun mountings in certain of her battleships in order to extend their range of fire, voted money for similar alterations to thirteen American ships. The information supplied to Congress was inaccurate, and when that fact became known the vote was cancelled. The British Government has always maintained that any increase in the angle of gun elevation would be a breach of the Washington Treaty, and notes to that effect were addressed to the United States and Japan on July 30th, 1924.

Danger from Floating Petrol.

CONSIDERABLE anxiety was felt in Liverpool on Wednesday when it was known that a very large portion of the 8000 tons of petrol, which had escaped from the grounded motor tanker Seminole, was being carried back into the Mersey by the return tide. The Mersey Harbour and Docks Board held in readiness over 1000 of its employees for salvage and fire-fighting service, but happily, owing to the stringent regulations enforced, their services were not needed. Particular precautions were taken to prevent flying sparks, or any other means by which the floating petrol might have become ignited. An officer of the Seminole was overcome by fumes while performing emergency duty. Had the spirit become ignited many miles of docks, etc., would have been involved. The accident happened at the time when the inquiry into the bringing of petrol-carrying ships further up the Thames was taking place.

Labour in Germany.

UNLESS some acceptable arrangement can be come to between employers and men in the German metallurgical industries there is a probability that all the works will be closed down. Employers are careful to explain that there is no illegal lockout, but that they are stopping operations because they are unable to continue if the men's claims are conceded. They are disposed to accord a part of the advance in wages asked for, but they refuse to entertain the question of an eight hours' day, which, they affirm, would mean an increase in the wages bill representing five times the total amount of dividends paid. The dispute is one of great social importance to Germany. Until now the eight hours' working day has rarely been observed, and in many industries the men have been working nine and ten hours a day, while the wages were lower than in most other countries. The German operative is fully alive to the improved conditions of the working classes elsewhere, and he is now endeavouring to secure the same advantages by agitating for an eight hours' working day and higher wages. The seriousness of the situation lines in the fact that the industry is not prepared for a reform of such magnitude. If the whole industrial fabric is not to be upset the reform must come gradually. It is being enforced by powerful labour organisations at a time when manufacturers are beginning to experience a reaction from the activity which was produced mainly by the low prices resulting from the low cost of production. If the claims are conceded German costs and prices must advance to something like the level of those in other countries. Such an advance at the present moment would threaten a collapse of German trade.

The Shannon Power Scheme.

No. III.*

EXCAVATING AND CONCRETING.

EXCAVATION on the power station site was begun in March, 1926, with two steam shovel excavators and a steam bucket excavator, for at that time the temporary power station had not been erected, and no electric current was available. Before reaching bedrock a considerable quantity of earth had to be removed, and it has been utilised for constructing the head-race banks in the locality. Generally speaking, rock was met with at from 12 m. to 16 m. (39ft. to 52ft.) below the ground level, after passing through varying strata of hardpan, gravel and sand with occasional layers of stiff clay. The rock, a carboniferous limestone, although partially weathered on the top for about a metre or so, gives a sound foundation.

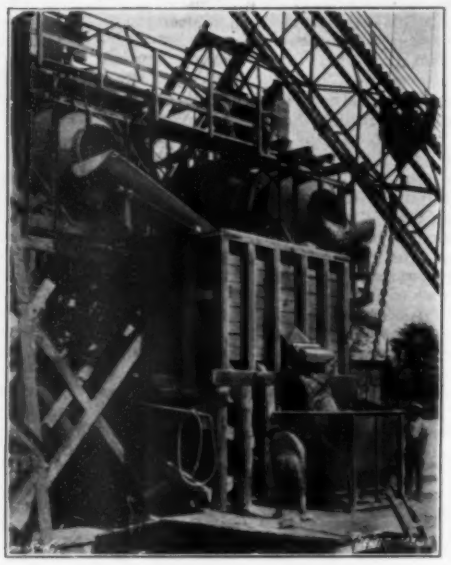


FIG. 24—CONCRETE MIXER ON CABLE CRANE

The excavation work for the intake building foundations at the power station was completed some months ago, and, at the time of writing, the concrete work—Figs. 35 and 36, page 686—is well advanced. Day and night this work continues, and some hundreds of tons of concrete are placed in position every twenty-four hours by a very efficient system. From the adjacent stone-crushing plant, to which we have alluded, graded aggregate is delivered by trains to the cement silo, where a specified weight of cement is added. The material is then dumped into hoppers and raised by means of an elevator to two large concrete mixers mounted on a cable crane—as shown in Fig. 24. Each of these concrete mixers has a capacity of one cubic metre (35·3 cubic feet), and is of the baffle-plate type. After half a minute dry and 2½ minutes wet mixing, the concrete is passed—see Fig. 24—into a 2 cubic metre skip, and is hauled to its destination by means of the cable crane—to be seen in Fig. 27. Although the entire mixing plant is concentrated on the cable crane, it is supported independently on a middle rail. The cement silo, a massive timber structure, is built in the immediate vicinity of the cable crane, and it serves also as a store and an arrangement by which the most economic handling and weighing of the cement can be effected The cable crane consists of a pair of steel towers having a height of about 40 m. (131ft.) and a cable spanning the 325 m. (1066ft.) gap between the apexes. As the towers run on parallel rails it is possible to make the crane serve an area of about 35,000 square metres, or 41,860 square yards. The maximum safe load the crane is capable of carrying is 6 tons, including the weight of the skip. The hoisting and travelling gear and the concrete mixing plant are all electrically driven. While the crane is employed mainly for placing concrete and machinery it has proved invaluable for other purposes. It has, for example, been employed in connection with difficult rock excavation work where it would be uneconomical to lay railway tracks for transporting the rock. A similar cable crane is being used for the construction of the weir, which we shall consider later.

* No. II. appeared December 9th.

FIG. 27—SLUICE HOUSE UNDER CONSTRUCTION

THE HEAD-RACE.

The full development scheme requires 500 cubic metres—say, 17,657 cubic feet—of water per second, and as the head-race is also to be used for navigation purposes, it was necessary to limit the maximum speed of the water, under exceptional circumstances, to 1·5 m. (4·9ft.) per second, and the cross-section of the head-race—see Fig. 28—had to be designed accordingly. Only a comparatively short section of the head-race is in cuttings; most of it has to be constructed partly in cutting and partly in embankment, and at one part the embankment reaches a height of 18 m., or 59ft. When the full development scheme is put into service, the water in the canal will be 11·2 m. (36·7ft.) deep, and the approximate width of the surface of the water will be 90 m., or 295ft. The bed of the canal is 31·5 m., or 103ft. wide. On the top the embankments are 3 m. (9·8ft.) wide, and the slopes on the water side vary between 1 : 2 and 1 : 3, whilst those on the land side vary between 1 : 3 and 1 : 5, calculation having shown that that formation will give the embankments good stability. Approximately 4½ million cubic metres (159 million cubic feet) of earth and over 300,000 cubic metres (10,594,440 cubic feet) of rock have to be excavated and transported along the head-race, and the removal of these quantities of material in the short time in which the contractors have undertaken to complete the work has necessitated the use of the latest and most up-to-date machinery available. For the most part, the earth is being excavated by six multiple bucket excavators—see Fig. 29—which have been supplied by the three firms, Krupp of Essen, Maschinenfabrik Buckau, of Madgeburg, and Luebecker Maschinenbau, of Lübeck. In all cases these excavators have a theoretical output of 375 cubic metres (13,243 cubic feet) per hour, the excavation reaching a depth of 17½ m. with a slope of 45 deg. The excavators are driven by three-phase motors designed for a pressure of 3000 volts, and the current is conveyed to the machine by a line running parallel with the excavator track, which is 300 m., or, say, 328 yards long.

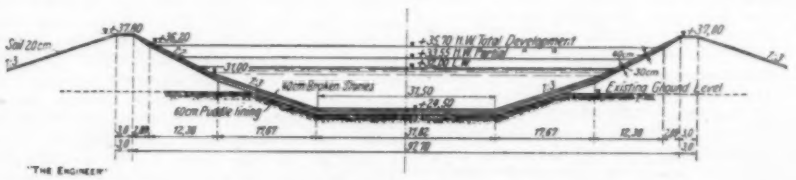


FIG. 28—CROSS SECTION OF HEAD RACE

TRACK SHIFTING MACHINE.

As will be seen from Fig. 29, the trains which transport the earth after it has been excavated run on a special track of 90 c.m. (say, 2ft. 11in.) gauge between the two excavator tracks, and they pass underneath the excavators, which, of course, also move. While the buckets are excavating the soil the earth is dropped into the trucks from the machine. When the last truck has been filled the foreman blows a whistle and the loaded train passes on and makes room for a train of empty trucks. It is impossible to excavate the canal by taking a single cut, and it is therefore necessary to shift the excavator track as the work proceeds. To perform this work in the ordinary way would be a long and tedious job which

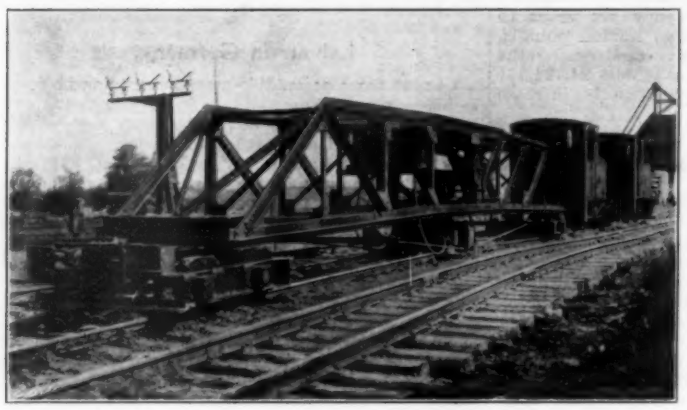


FIG. 25—TRACK SHIFTING MACHINE

FIG. 26—TRACK SHIFTING MACHINE IN OPERATION

would require about forty men with levers. By means of the Arbens-Kammerer machine—shown in Fig. 25—however, the trucks can be moved with

FIG. 29—KRUPP BUCKET EXCAVATOR AND TRANSPORTER

ease. The machine consists of a frame mounted on bogies at the ends, whilst in the centre hand-operated

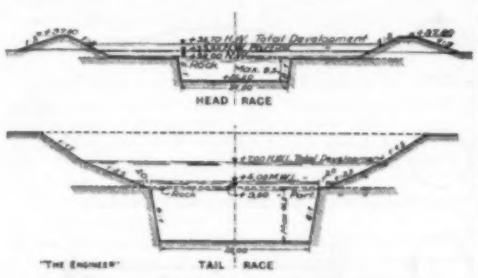


FIG. 30—CROSS SECTIONS OF ROCK CUTTINGS

gear is provided for lifting the rails and sleepers and deflecting them in the direction required. Briefly, when it is desired to shift a track two grooved horizontal wheels above each of the rails on which the machine travels are made to grip the rails. By means of hand-operated gear the rails and sleepers are then lifted above the ground when the rails and sleepers are deflected or pushed from the existing position in the direction it is desired to move the track. On starting the locomotive to which the rail shifting machine is coupled the rails and sleepers are caused to take up a new position because the grooved horizontal wheels which grip the rails have been displaced from the centre of the machine. As the rails for the bucket excavators and train of trucks are fixed to the same sleepers, all these rails are moved simultaneously in the desired direction. From the illustration—Fig. 26—which shows a track being moved, the scheme should readily be understood and the immense advantage of the machine will also be appreciated. In order to keep the horizontal wheels which grip the rails cool, water drawn from a tank mounted on the machine is sprayed on the wheels all the time the machine is in operation.

BLASTING.

As we have said, the construction of the head-race involves both excavation and banking, but before dealing with the building up of embankments, for which purpose very interesting machines are in use, brief reference should be made to the blasting operations for the removal of rock. In two sections of the head-race and practically in the whole length of the tail-race rock has to be dealt with, and, needless to say, it involves much additional work and expense. On the other hand, the rock is useful for the foundations for the power station, the weir, &c. In all, approximately one million cubic metres (say, 1·3 million cubic yards) of rock have to be excavated, the bulk of which, namely, 600,000 cubic metres (784,772 cubic yards) is in the tail-race and at the power station. In the head-race 300,000 cubic metres (392,386 cubic yards) have to be removed near Clonlara and above O'Briensbridge. Above O'Briensbridge the rock can be geologically classified as belonging to the Devonian or old red sandstone, whilst below O'Briensbridge, near the city of Limerick, the engineers have met with carboniferous limestone with occasional erratics at the top, deposited in the glacial period. The drawings—Fig. 30—show the normal cross-sections of the rock in the head and tail-races. The bottom of the canal is being cut in rock 31·5 m. (103ft.) wide, and the banks of the canal attain a height of nearly 10 m., or 32·8ft. At the time of writing the tail-race is only being excavated to meet the needs of the partial development scheme with a bed 22 m. (72ft.) wide, and there the deepest cut in rock is 15 m., or 49ft. wide, the slopes of the cut being 6 : 1. In view of the short time that the contractors have been allowed for carrying out the work, it has been necessary to pay special attention to the blasting operations, and to employ special machines for boring the holes. Experience soon indicated that satisfactory progress could not be made with compressed air-boring machines, because the drills became locked before they had gone down very deep into the clefts and crevices of the stone. Moreover, before new bores can be made the rock surface must be cleared of the loosened material, an operation that involves considerable delay. By the employment of drop hammer boring machines—as shown in Fig. 34—however, all difficulties have been overcome. Built on the principle of the oldest and most primitive

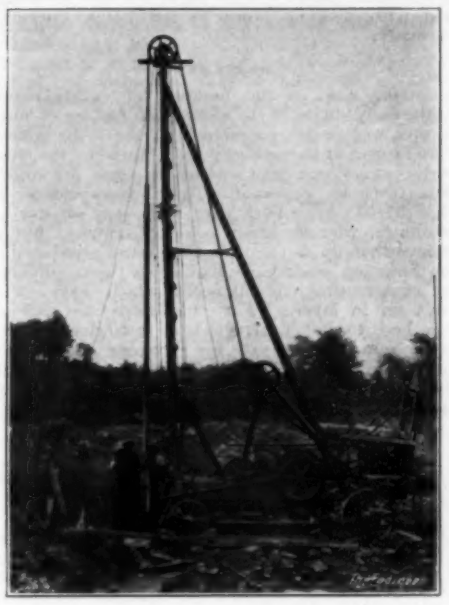


FIG. 34—BORING MACHINE

boring appliances, but with modern improvements, these machines have met the requirements admirably. A heavy boring tool or chisel merely drops at regular intervals and pierces the rock without difficulty. Any number of bores can be made to any desired depth without interfering with the work of the excavators. Some idea of the efficiency of the method of blasting employed can be gained from the fact that on the tail-race three bore-holes of 200 mm., say, 8in., inner diameter are sufficient to blast approximately 1000 cubic metres (35,314 cubic feet) of rock, the height of the rock face in this case being 6 m., or 19·6ft. For finishing the blasting work, such as the removal of protruding pieces on the bed and sides of the canal and for splitting up the larger blocks of rock, compressed air boring machines are still used. Ammonite and ammonite-gelatine are the explosives employed, both of which are individually

FIG. 31—TRANSPORTER IN OPERATION

FIG. 32—TRAIN BRINGING MATERIAL FOR TRANSPORTER

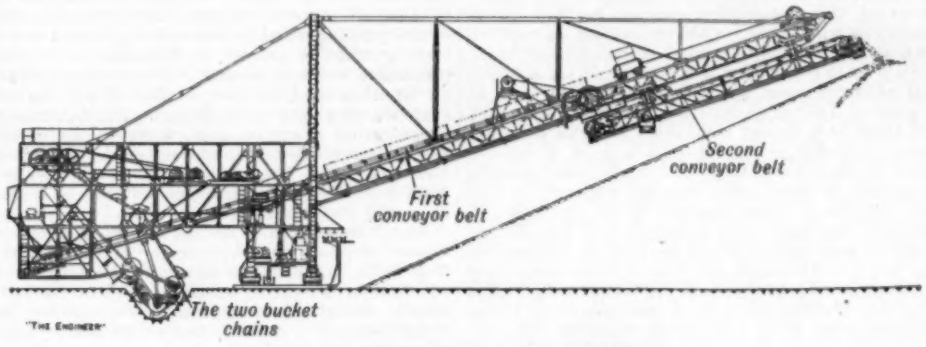


FIG. 33—ARRANGEMENT OF TRANSPORTER

safe in the case of fire or frost, and they cannot be exploded by blows or ordinary concussion. The rock is put into trucks on the building sites by shovel excavators, some of which travel on rails, whilst others are provided with caterpillars to enable them to move over ordinary ground. The normal loading capacity of the excavators is 200 cubic metres (7062 cubic feet) of rock per shift. For taking the rock away special trucks with a capacity of 4·3 cubic metres (152·0 cubic feet) are used. The trucks are made of steel, and they have proved to be highly suitable for transporting rock, not only in connection with the Shannon power scheme work, but also in connection with previous work in the Black Forest of Germany.

EMBANKMENTS.

Coming now to the building of embankments. In the early stages of the work when the use of transporters was under consideration, the embankments were formed in the ordinary way, but when the transporters were put into operation, their advantages soon became apparent. These transporters—see Figs. 31–33—have been used with very satisfactory results for winning brown coal in Germany, but we believe that up to the time they were introduced on the Shannon work they had never been employed for constructing embankments which have to be built up in layers. For this work the tansporters had to be constructed on somewhat different lines from those used for winning brown coal in German mines. They had to be capable of raising the material to a height of 18 m. (59ft.). and of dumping the earth on to any desired spot over a considerable width. The former condition had already been complied with in the design of a transporter at the Krupp factory for work in the mines known as Elise II. in Mucheln. On the general principle of this machine, the transporters for the Shannon scheme were designed by three firms, viz., Krupp, Luebecker Maschinenbau, and Maschinenfabrik Buckau, to the specifications of Siemens Bauunion. Briefly the method of working is as follows: The trains bring the earth and discharge it into a trench about 2½ m. (8·2ft.) deep, previously excavated by the transporter. After the trench has been filled with loose earth, the bucket chains of the transporters—having buckets interchangeable with those on the excavators—scrape up the material and empty it into a storage hopper which drops it on to a conveyor belt supported on a boom. This conveyor runs up a gradient of 20 deg. at a speed of 1·5 m. (4·9ft.) per second. Under this belt there is a second belt which can run in either direction, and it is carried on a support which can move up and down the main boom, thus making it possible to deposit the material wherever desired over a width of approximately 40 m., or 131ft. A difficulty that had to be grappled with was that of handling large stones which have to be transported together with the earth, but it has been overcome, and it is now possible to deal with 1500–2000 cubic metres (53,972 to 70,629 cubic feet) of materials in ten hours. Embankments built with these machines are very solid, as the height from which the material is dropped has the effect of ramming it in. In order that the material in the bank may be watered as desired, a sprinkling device is fitted to the lower boom. For the most part, the embankments can be made without moving the transporter track. Only in some parts where the embankments are unusually wide, is it necessary to shift the rails which, of course, is done by the track-shifting machine already described.

When the embankments have been formed they are allowed to settle and the slopes and tops are then dressed by hand. Finally, a layer of surface soil 20 cm. (8 in.) thick is placed on the top and outer slope by the transporters. Each transporter can easily deal with the output of two large bucket excavators, which sometimes construct the embankments, together with the transporters in the manner shown in Fig. 29. All these transporters are electrically driven, and the three-phase current is obtained from a line at the side of the rail track. We give in Figs. 35 to 40 on page 686 views of work being carried out at the power-station site and at the Weir.

(To be continued.)

The Cause of Wheel Wobble.

By TELFORD PETRIE, D.Sc.

UNDER a certain combination of circumstances it is possible for the front wheels of a motor vehicle to move rapidly from side to side about a vertical axis passing through their hubs. The effect, as the car progresses forward, is to impart a wobbling motion to the front wheels, which may be so persistent that nothing short of stopping the car will eliminate it. The phenomenon is known by various names, amongst which may be mentioned "wheel wobble," "shimmying," or "wheel flap." The reason for its occurrence, which is not new or confined to any particular make of car, does not seem to have been properly explained, and it is the purpose of this article to suggest a possible cause.

Some designers consider that there are two kinds of wheel wobble, one which occurs at speeds of under 20 m.p.h., and called "low-speed" wobble, and one which is found occasionally in racing cars at or over about 50 m.p.h., which is known as "high-speed" wobble. It is claimed that with the former the front wheels do not actually leave the ground, whereas with the latter the wheels alternatively lift clear of the track and the front of the car bounces from side to side. It has been suggested that gyroscopic action of the rotating wheel occurs with high-speed wobble, causing what is known in dynamics as "conical precession without torque."[1] Low-speed wobble, on the other hand, has been attributed, without much evidence, to a steering oscillation. The results of the investigation described here, however, go to show that there is no reason to make any distinction between high-speed and low-speed wobble, and that it is possible to give an explanation that can be made to fit in with the known facts.

In all investigations of this nature, it is a sound maxim to start by searching for and determining, if possible, the cause or causes of the phenomenon which it is desired to remove. Such a method of attack, though often appearing to introduce delay when a remedy is urgently needed, leads most rapidly to the complete cure, if such can be found. As a general rule, it is possible by a careful survey of the relevant literature, to ascertain what knowledge already exists on the subject; but the only result of applying this method to wheel wobble was to find that the problem still awaited solution.

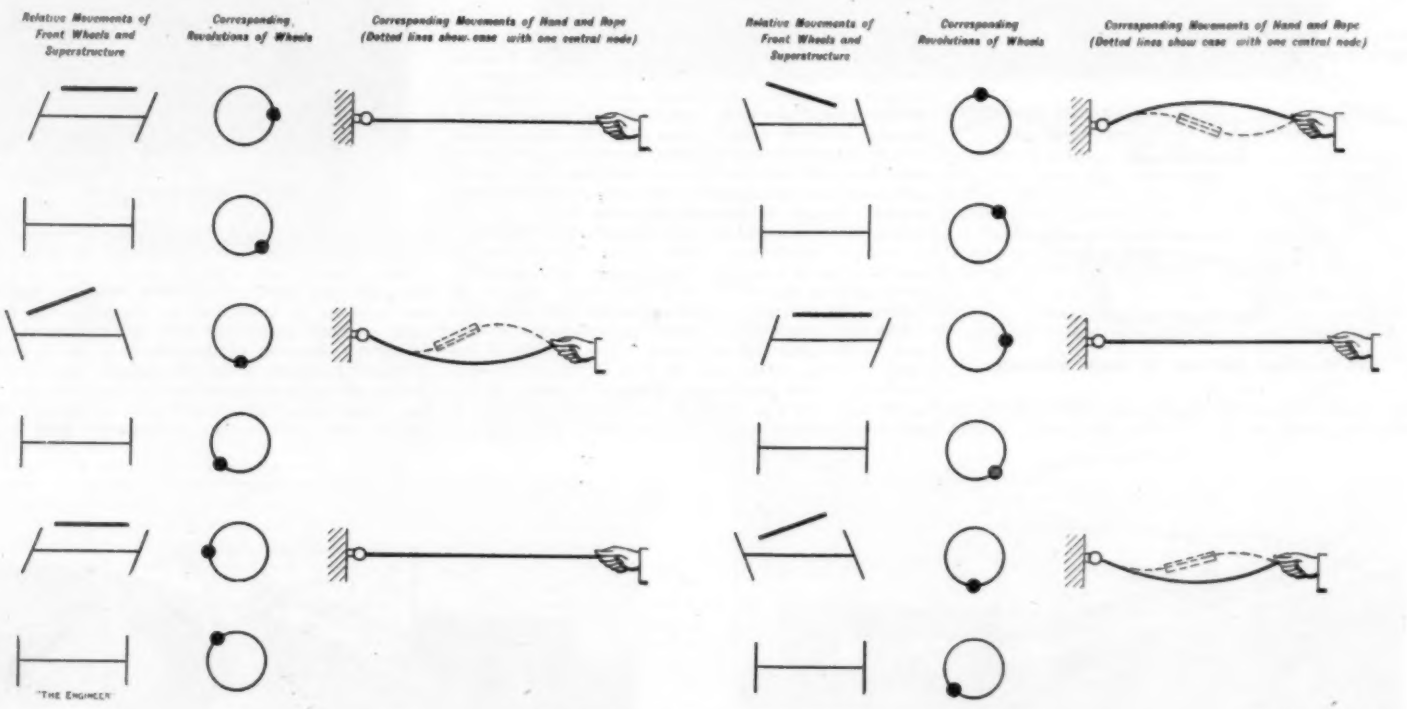
The general nature of the phenomenon pointed to some natural periodicity in the mechanism of the whole car, coinciding at a certain speed—or speeds—with an imposed force, whose nature was also periodic. When two such effects were "in step" the one would pile up the other, much as a child in a swing may be sent sky high by a series of gentle but well-timed pushes, or, to take an example from engineering, in the way in which a heavy turbine or alternator rotor may "whip" or "whirl" when run at certain critical speeds. One of the peculiarities of this effect is that both the amplitude of the vibrations and the imposed force may be very small in themselves. When one is imposed on the other, however, the movements are greatly magnified, and theoretically may reach infinite proportions.

EXPERIMENTAL EVIDENCE ABOUT WHEEL WOBBLE.

Such considerations suggested that the best line of investigation would be to try and detect some natural periodicity in or about the car, and a periodic force which could react on and magnify it. For this purpose a car, which had already shown signs of wheel wobble, was purposely loosened in all its salient joints so that its tendency to wobble was accentuated. The driver soon became so skilful in its manipulation that he was able to produce a wobble whenever he ran over a pot-hole or other obstruction in the road at the proper speed. It was found, however, that wobble would not start without some initial impulse from outside. In this connection it is of interest to note that, on one occasion, a brick was used for starting wobble on a smooth road surface. It was then noticed that a glancing blow was required, and that a direct course over the middle of the brick was not operative. This pointed to the fact that a starting impulse should come from one side of the wheel.

Various methods were tried to obtain a measure of the movements of the car and its wobble. The one which yielded the most satisfactory results was the use of a Cine-Kodak, and the subsequent enlargement of the salient portions of the film. In order to detect the revolutions of the wheels a blob of white paint was placed on each of the front wheel rims and tires. The exposed cinema film was returned from the Kodak Company as a positive, and the resulting enlargement therefore produced a negative. It was, however, not necessary to reverse this again, as the white spot showed up black on a white rim, and could readily be detected. The timing of the film was checked by photographing an observer when swinging his arm in time with a seconds stop-watch. This method, though a rough-and-ready one, was sufficiently accurate to show that sixteen pictures corresponded with one second in time.

Two reels, each of 100ft. of film, were taken of the car under different conditions, and the results subjected to a careful analysis. It was found that there were three relevant motions—the revolutions of the wheel, the wobble of the wheel, and a transverse or criss-cross vibration of the sprung superstructure of the car. The first two were not difficult to detect and to time. They were taken over as many pictures as possible and averages obtained for each test. The swing-swang effect was not quite so definite in every case. The period was computed by drawing straight lines down a number of consecutive pictures, after checking that the camera had not moved laterally


Relative Movements of Front Wheels and Superstructure
Corresponding Revolutions of Wheels
Corresponding Movements of Hand and Rope (Dotted lines show case with one central node)
Relative Movements of Front Wheels and Superstructure
Corresponding Revolutions of Wheels
Corresponding Movements of Hand and Rope (Dotted lines show case with one central node)
"THE ENGINEER"

DIAGRAMS ILLUSTRATING WHEEL WOBBLE

[1] "Front-wheel Wobble," by A. Healey, "Proc.," Inst. Aut. Eng., Vol. 19, 1924–25, page 838.

by drawing a second straight line through some stationary point on the photographs.

The examination of some 370 separate pictures gave the following table of average results :—

Speed, m.p.h.	Wheel revs.	Periods per minute. Wheel wobble.	Swing-swangs of car body.
8·25	96	240	120
10·8	125	259	128
12·2	142	256	128
20·6	240	296	149

The ratios of these figures to one another are as follows :—

Speed, m.p.h.	Wobble to Wheel revs.	Wobble to Swing-swangs.
8·25	2·50	2·00
10·8	2·07	2·02
12·2	1·80	2·00
20·6	1·15	2·00

If these results are cross-plotted, it will be found that the ratios in both cases are exactly 2 under the following conditions :—

Speed, m.p.h.	Wheel, r.p.m.	Wobbles per min.	Swing-swangs per min.
11·2	130	260	130

and this seems to be the natural condition under which wobble in this particular car was started and maintained.

These figures assume increased importance when it is pointed out that the phenomenon of wobble could only be started (with this particular car) at a speed of between 10 and 12 m.p.h. Once started, however, it would maintain itself at other speeds; therefore, in order to get photographs at the other speeds, the car had first to be run at about 11 m.p.h., and then the speed adjusted afterwards without breaking the wobble.

Deductions from Experiment.

The facts which emerge from this investigation are :—

(*a*) Wobble starts when the revolutions of the wheel correspond with the natural criss-cross periodicity of the slung portion of the car.

(*b*) The period of wobble is just twice as fast as the natural criss-cross movement of this superstructure.

(*c*) A sharp side blow on a front wheel is necessary to start wobble.

It would appear that all these have to occur simultaneously in order to start wobble, and that once started only condition (*b*) is essential to maintain wobble.

The problem therefore seemed to resolve itself as follows :—

The car vibrates to and fro about a horizontal axis with a number of swing-swangs per minute.

The wheels revolve, also about a horizontal axis, with the same number of revolutions per minute as there are swing-swangs.

The wobble, however, when once started, causes the front wheels to move to and fro about vertical axes, twice the number of times per minute as the first two movements.

It is perhaps difficult at first to discover the reasons why these apparent synchronisms should occur, and more especially whether there is any underlying principle of vibration connected with them, or whether they just happen to be coincidences found in this particular car.

A simple experiment, however, should show how they may come about—see the diagram.

If about 10ft. of rope is fixed at one end to a point about 4ft. from the ground, and the other end held fairly taut in the hand, it will be found that when the hand is moved across the rope, there is a natural periodicity when both can be made to move together in unison with the minimum of effort. If, now, the hand is moved in and out along the rope, a little practice will find a condition when the rope still moves to and fro with the same periodicity as before, but the hand is then moving in and out at just double speed.

In this analogy the swinging rope represents the criss-cross vibrations of the car. The first to-and-fro movement of the hand—in step with the rope—represents some periodic up-and-down force imposed on the end of the axles by the revolving wheels. This force may be caused in several ways. The wheels may not be perfectly balanced, the inertia effects of both wheels may not be quite the same or the track may be uneven. Only the smallest impulse is necessary provided it is periodic.

The second in-and-out movement of the hand—twice as fast as the movement of the rope—corresponds to the effect of wheel wobble on the motion of the front axle. As the wheels turn in and out they move the king pins to and fro across the car, and so keep the car vibrating in half time.

This rope analogy has been given here in its simplest or most fundamental form, in order to show how it is possible for two vibrations, moving at right angles to one another, to exist in an "elastic" structure, when the period of one is double that of the other. It is based on the well known experiments of Melde on vibrating strings,[2] who showed that it could be extended to include one, two or more nodes in the cord. The case of the wobbling car would appear to correspond more closely to that of a rope vibrating with a central node; a condition which can sometimes be reproduced in the rope by a more rapid movement of the hand.

The mathematics of this type of maintained vibration have been worked out by Lord Rayleigh.[3] They show that the amplitude of the wobble—*i.e.*, the magnitude of motion to and fro—is a factor in the case. If it is less than the product of its periodicity and the damping effects in the whole system, it appears that wobble cannot be maintained. In other words, sufficient energy is not supplied to overcome the energy which is dissipated by a friction, &c. When the amplitude equals the above product, the energy is just balanced and the wobble will continue; whilst if it becomes still larger, the balance between energy supplied and energy dissipated is attained by such an alteration of phase between the two sets of vibrations as shall diminish the former quantity to the required amount.

It is an interesting fact, as Sir James Henderson pointed out in discussion at the recent meeting of the British Association in Leeds, that when resonance is set up in a structure by two—or more—types of vibration, the energy to maintain it may come from either the fundamental or from a harmonic. In the case of wheel wobble, once the phenomenon has been started, it appears to come from the criss-cross vibration of the spring superstructure. If that is so, the conclusion to be drawn is that the wobble will die out if the rolling or sideways movement of a moving vehicle can be kept within suitable limits.

This is a fortunate addition to the apparent facts about wheel wobble. For if wobble can always occur under the circumstances just described, it would be a difficult matter to design a moving vehicle, with its varying conditions of service, in such a way that the periodicities involved never coincided in a dangerous manner. On the other hand, it is quite feasible to arrange the original design and conditions of loading, so that the tendency to excessive oscillation is sufficiently checked. An examination of the various "wobble" and "shimmy" eliminators on the market will show that their effectiveness depends on the extent to which they embody this principle.

Principles of Vehicle Suspension.

It would appear that wheel wobble is a natural phenomenon which is present in all types of sprung vehicles with articulated front wheels, and it therefore is of interest to run briefly over the principles of motor car suspension and examine them from that point of view.

The ideal to be aimed at is to provide a design in which the wheels will follow all the inequalities of the road with uniform adhesion without transmitting any of them to the sprung portions of the car. Many arrangements of springs are possible, but it makes no difference to the safety of the vehicle on the road, what shape or arrangements of springs are introduced between the unsprung axles and the frame, provided that due precautions are taken and that the attachments to the axles are in the same points relative to the car. The springs themselves may be transverse or longitudinal, or inclined at an angle of 45 deg. to the direction of motion. They may be laminated or helical or take up any other form. The general effect on the running of the vehicle will be the same in every case, provided the axles are similarly placed with regard to the frame and that the total stiffness or deflection of the spring system remains the same.

This fact was well brought out by Mr. A. A. Remington, a former President of the Institution of Automobile Engineers,[4] when he referred to four common groups of car suspension, namely, semi-elliptic, cantilever, half-cantilever, and transverse springs. To quote his words :—

> "These four forms of suspension make no difference to the external effect, provided that the axle is articulated in respect to the frame in the same manner, but they only modify the internal effect, particularly as regards the stresses and stress distribution in the various members."

With regard to the last part of this sentence, it is not always realised that transverse springing may have an advantage as regards internal stress distribution, since it is possible to attach the springs nearer to the wheel hubs, and so keep down the axle stresses. It is also found that a transverse arrangement is, in general, better when dealing with inequalities on the two sides of the track.

Every system of springing gives a natural periodicity or up-and-down vibration to a car, and for comfort this should be of the order of 90 to 100 swing-swangs per minute. There may be, in addition, two other motions—a fore and aft pitching effect and a side-to-side rolling movement. It is the magnitude of this last motion which appears to have a bearing on the maintenance of wobble. In a good design the degree of this oscillation can be controlled, for the most part, by the relative stiffness of the springs, the method of attachment of springs to the frame, the position of the centre of gravity of the superstructure relative to this attachment, and the distribution of the load across the vehicle.

With regard to stiffening up springs, whilst this is perhaps the neatest cure to apply to a car that has already become prone to wheel wobble, it is not altogether desirable for other reasons to carry it too far in a new design. It is better in this case to increase the camber or to adjust the attachment between spring and frame, so as to reduce the amplitude of the rolling movement as much as possible without interfering with the natural up-and-down periodicity of the car as a whole. In this respect again, properly designed transverse springs have the advantage, as Mr. H. S. Rowell has pointed out,[5] since their "attachment to the chassis may be high and the rolling stiffness can be made large."

The position of the centre of gravity of the superstructure, as opposed to that of the car as a whole affects the amount of rolling in proportion to its height above the neutral point of transverse oscillation. It is not altogether under control of the designer, owing to variations in load distribution, but a "top heavy" vehicle will supply more energy for maintaining a roll than one in which the main weight is kept low. The distribution of the load may also prove a dividing line. In one trial during the experiments it was found that wobble could not be maintained when only the driver was up, but that the presence of a passenger alongside produced it without difficulty.

In the former case the unsymmetrical load had a damping effect on the magnitude of the vibration, and sufficient energy was not imparted to the system. In the latter, the two balanced outside loads tended to increase the amplitude.

In conclusion, it should perhaps be pointed out that the above considerations concern what might be called the first wobbling speed, but that, by the theory of vibrations, there are possibilities of other and higher wobbling speeds which would be caused by multiples of the fundamental periods involved. That this is so, may be indicated by the fact that, in Melde's experiments, it is possible to maintain vibration at higher speeds with two or more nodes in the string.

[2] See, for instance, Tyndall's "Sound," fourth edition, 1883, pages 103 *et seq.*

[3] "Theory of Sound," 1894, Vol. I., pages 81–85, or his collected scientific papers, No. 97, Vol. II., pages 188–193.

[4] In a paper on "The Design and Functioning of Laminated Automobile Suspension Springs," "Proc.," Inst. Aut. Eng., Vol. 16, Part II., 1921–22, pages 203 *et seq.*

[5] "Principles of Vehicle Suspension," "Proc.," Inst. Aut. Eng., Vol. 17, Part II., 1922–23, page 510.

South African Railways and Foreign Competition.

(*By a Special Correspondent.*)

During the last two years British firms have been singularly unsuccessful when orders have been placed for locomotives by the South African Railways. Discussion on the subject has been general, and the reasons put forward for the failure of home makers have not been convincing. Up till about five years ago British firms had made about 90 per cent. of the locomotives used in South Africa, but since then foreign firms have increased their hold on that market to a disturbing degree, particularly in the heavy types of engines used for long-distance trains.

Locomotives.—That the South African Railways' requirements are considerable is shown by the fact that tenders were due on November 13th for the following engines :—

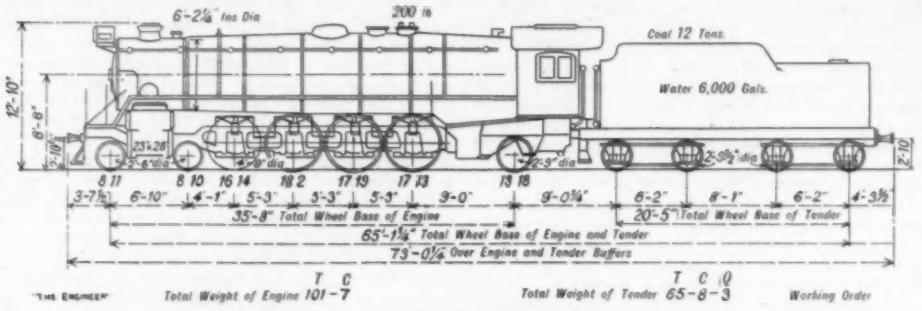
Type.	Quantity.
Class "15 C."	39
"16 D."	5
"G.C.A."	29
"G.D.A."	16
"G.E."	1
"G.G.A." or "G.F."	12
"G.F."	38
"19"	4
"12 A."	6
"N G/H D"	2
Shunting	14
Total	167

By the time this is being read the tenders received for these 167 engines will be under consideration.

When it is borne in mind that the South African Railways are Government-owned it will be realised that the Tender Board must give strong reasons for its action, should it not recommend the acceptance of the lowest tender. Therefore price, if not the only, is certainly the first consideration. Compliance with requirements is next in importance, and time of delivery, under the stipulated penalties, is a leading factor in making decisions. There is not, and there never has been, any question of unfairness. If bias does exist at all—and even members of Tender Boards are human—it is probably, in this case, in favour of the British article. The most successful competitors have been American makers, and to discover the reasons of their success in obtaining orders is to find the causes of British failure to do so. In many ways the South African Railways approach American railway conditions more closely than European. On American railways all vehicles are fitted with power brakes; on the South African Railways each vehicle has an automatic vacuum brake. American engines are universally fitted with steel fire-boxes; in England the copper fire-box is standard. In South Africa, steel, instead of copper, has been used in certain types of locomotive fire-boxes for a considerable time, and with the contemplated general

adoption of steel for this purpose, American experience gives its makers an initial advantage. American railways use grease lubrication, which is almost unknown in England; this method of lubricating axle-boxes and rods is suitable to South African conditions. America has adopted mechanical stoking on large engines; the South African Railways, with engines with a tractive force of 50,000 lb. and over, must also adopt that system.

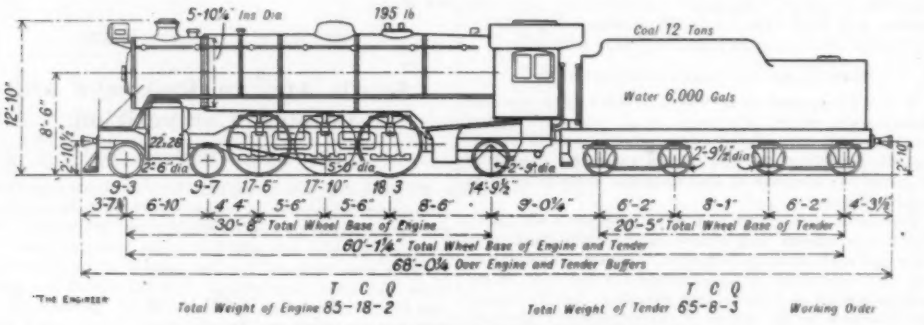
These are some of the points in which the Americans, from the South African Railways' standpoint, are in advance of the British, mainly owing to the fact that



SOUTH AFRICAN RAILWAYS—LOCOMOTIVE TYPE 15 C.

the physical conditions of the American railways approximate to those of the South African Railways more closely than do those of Britain.

The conditions of South African railway traction are severe. Gradients are as steep as 1 in 30 with curves (nominal) of 300ft. radius; these gradients are gradually being eliminated in favour of a 1 in 65. The main line from Cape Town has now that gradient, except on the Hex River section, which is still 1 in 40. Distances are great, loads are heavy. The line is single for the most part, and the gauge is only 3ft. 6in. With the growing exports of mealies and coal, heavy



SOUTH AFRICAN RAILWAYS—LOCOMOTIVE TYPE 16 D.

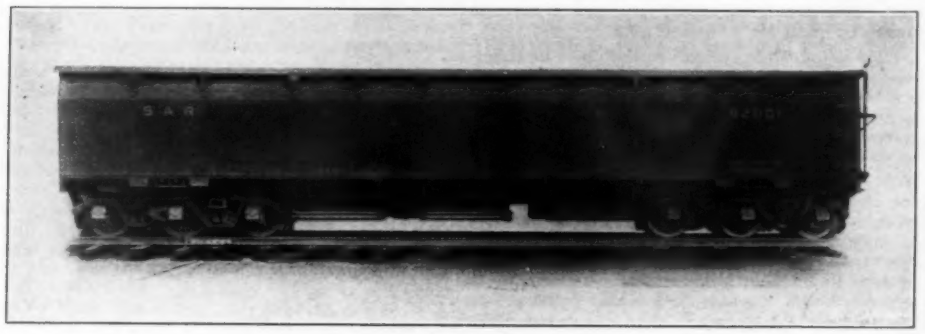
traffic has increaed beyond all anticipations. In these circumstances the management has, naturally, sought and obtained what assistance was renderable by managements working under similar conditions. The American makers were alive to the position. They attracted the visits of South African Railways' engineers to their country and sent the best of their own people to South Africa to study the conditions on the spot and push, personally, the claims of their productions. Above all, and this is perhaps the vital point, they accepted without reserve the conditions of the South African Railways and guaranteed the successful working of their engines in South Africa under the severest penalties.

The evolution of South African Railways locomotive traction began in earnest about 1905, when a Kitson-Meyer articulated engine was obtained from Kitsons, of Leeds. Then, in 1908–1910, came the "Mallet" type, mostly from America. These engines were followed by five Mallets, "M.H." type in 1915, built by the North British Locomotive Company. Soon after the war two "Garratts" were tried and found satisfactory, and quite a large number of them were built by Beyer, Peacock and Co. The North British Locomotive Company, in competition, introduced the "Fairlie" in considerable quantities. Later, manufacturers offered either type, and as the result of open tenders the last orders went to the Continent, on price.

The first order for Classes "15 C." and "16 D."—two of each—was placed direct with the Baldwin Company, and so was the next order for ten "15 C." and five "16 D." The last order, for twenty-three Class "15 C.," was on open tender and went to the American Locomotive Company, its price being lowest and its guarantees being acceptable. The Baldwin engines were quite satisfactory in every respect. There has been trouble with the frame castings of the American Locomotive Company's engines, but these frames are being replaced at the makers' cost under the terms of the contract. A number of engines has recently been ordered from Germany, the price being the lowest tendered. The work and material of the German-built engines are of the best.

Among the tenders now under consideration are some for thirty-nine engines of Class "15 C." type and five of the type "16 D." These types were first supplied by the Baldwin Company under severe guarantees, and have been quite satisfactory. The next and only other order for them was obtained by the American Locomotive Company in open competition. As British firms have not yet succeeded in obtaining any orders for these classes and as further supplies will be necessary from time to time, copies of blue prints with dimensions are reproduced by the courtesy of the South African Railways.

Carriages and Wagons—A great deal of the South African mineral traffic is coal, and for it big wagons are held to be essential. For many years 100,000 lb. capacity wagons, built by the Leeds Forge Company, have been used. It was found that the Virginian Railways were using wagons of 120 tons capacity,



SOUTH AFRICAN RAILWAYS—150,000 lb. WAGON

and the firm which supplied them was given an order for twenty wagons of 150,000 lb. capacity. As a result of this test it appears that 100 tons capacity will be possible on the 3ft. 6in. gauge. A photograph of the wagons in use—150,000 lb.—is reproduced.

The automatic coupler as developed in America has been in use on the South African Railway coaches for the last twenty-five years. Wagons are now being fitted with it, the latest American practice being followed; Europe has hardly touched the automatic coupler.

British firms still secure the bulk of the orders for wagons. The Continent and America are, however, keen competitors. In the case of a recent order for 2000 grain wagons a Belgian price was the lowest, and, as a trial, an order for fifty of the wagons was placed with the Belgium firm and one for 1950 with British firms. The time taken to build in Belgium was excessive, and as a result the next order was placed direct with the British firms. Other orders for smaller wagons were placed in France and Belgium, on price; the material, workmanship and delivery were quite satisfactory.

As regards coaching stock, the South African Railways build 50 per cent. of their requirements. The balance is obtained mainly from Great Britain, but competition is keen and several orders have gone to the Continent, on price.

At the present moment sixty-six coaches are under construction for South Africa by the Metropolitan Carriage, Wagon and Finance Company, the Birmingham Railway Carriage and Wagon Company, Ltd., the Midland Railway Carriage and Wagon Company, and Clayton Wagons.

Institution of Chemical Engineers.

CONTINUING the practice adopted for the first time last session, the Institution of Chemical Engineers is again holding two three-day conferences instead of monthly meetings. The first took place in the rooms of the Chemical Society, Burlington House, London, on December 7th, 8th and 9th, and the second will be held next March. Whether this plan is the best from the point of view of drawing the members together in greater numbers may be a matter for consideration in the near future, because there is no hiding the fact that, at more than one of the five sessions held during the Conference last week, the attendance was disappointing. On the other hand, the discussions were for the most part very good, and in the case of one paper there was nothing like the time available to do justice to it or to hear all the speakers who desired to take part in the discussion.

SUBMERGED COMBUSTION.

The only paper read on Wednesday, December 7th, was entitled "Submerged Flame Combustion," and turned mainly on the Brunler boiler, in which the flame is produced and burned in the liquid it is desired to heat. The author was Mr. Norman Swindin, and as he points out in the paper a complete history of submerged flame combustion would have to record the academic work of Faraday, Bunsen, Dixon, Bone, and their collaborators, but the real practical applications of this method have centred around the work of Brunler, although many types of burners for this purpose have been patented since 1887. The fact is that at present there are no types of such burners on the market, although two or three firms are known to be studying the system. The paper, therefore, was written solely to give an idea of the progress that is being made and to sweep away, possibly, the scepticism with which submerged flame combustion has met from time to time. Mr. Norman Swindin became interested in submerged flame combustion from having to heat a solution of brine containing hydrochloric acids and other corrosives. When all other methods failed, he was able to make a fairly successful submerged flame burner, and from his subsequent study of the process he has come to the conclusion that the system has been retarded in its development by reason of the absurd claims which have been made regarding the efficiency to be obtained; in fact, a thermal efficiency has been claimed greater than that represented by the heat units in the fuel used. Mr. Swindin has also come to the opinion that a reason for non-success in the past has been that the inventors who have studied the problem have not shown sufficient grasp of the essential principles; indeed, we are, as he said, only just studying the nature and theory of combustion and establishing the theory.

Looking at the matter from this point of view, Mr. Swindin laid down the following necessary conditions for submerged flame combustion:—

(1) The fuel must be liquid, gaseous or sufficiently divided if a solid so that it can flow or be blown through small orifices and pipes.

(2) The air or oxygen-containing gas must be carefully controlled to form a constant combustible mixture.

(3) The fuel and air must be thoroughly mixed and passed through a tube of such a size that the velocity of flow is greater than that of the rate of propagation of flame, which depends on the composition of the gas; it is usually 3ft. per second.

(4) The combustible mixture must be burned in contact with a hot spot or incandescent surface in order to increase the rate and ensure completeness of combustion and to keep the flame alight.

(5) The burner chamber must be of such construction and be made of such materials that a constant temperature of the walls is maintained below that of fusion of the lining and so high as not to cool a portion of the gas below its combustion temperature.

(6) The burner must be used in such a way that the products of combustion do not affect the vessels and plant and the substances being evaporated.

(7) The working pressure must be adjusted so that the partial pressure of the steam does not unduly lose the heat.

A word of explanation is called for in connection with the last clause. We quote from the paper: "To maintain a solution of liquid at any definite temperature is much more difficult than to evaporate it. The effect of air on the surface of the liquid is to reduce the temperature in proportion to the quantity of air permitted to enter the vessel. When the submerged flame burner is used for heating and the products of combustion mingle with the vapours, the temperature is affected still more. Here the Partial Pressure Law operates, and to govern the temperature the pressure must be controlled."

For the rest, the paper was a fairly complete review of the whole question, including the theoretical and practical aspects, particular attention being paid to the refractory

material for lining the combustion chamber. Experimental work is being carried out in this country, and the first plant is being erected here, from which it is hoped to obtain results of an extremely valuable nature.

In the discussion, the question was immediately asked as to the advantages of the submerged flame burner from the practical point of view, and it was generally conceded that as a means of power production it will have to remain in the background for a long time. On the other hand, it was urged by Mr. Norman Swindin in his reply that, even in the present development of the process, it could be applied for the heating of colour solutions in the dyeing industry, in the evaporation of ammonium chloride, and the heating of bath water in laundries if only those concerned in these industries would have sufficient courage to make a start. Mr. Swindin expressed himself as impatient when people held back from giving a trial to new processes because they wanted to make quite certain that they would be fully successful from the start. Indeed, he went farther and claimed that those who were endeavouring to develop this process had a right to expect some help from industry.

An interesting feature of the discussion was the disclosure by Dr. W. R. Ormandy that it had been possible to get a few wealthy English people to put their hands in their pockets and provide an adequate sum of money, to prove either that the submerged flame burner is capable of being made a practical success or is useless. These people, he said, were willing to take the profits if successful, or, if unsuccessful, would be content with the satisfaction that they had done their best to help industry.

Refrigeration.

On Thursday, December 8th, the Conference devoted itself to the consideration of three papers on various aspects of refrigeration, these being "The Design of Refrigerating Plants," by G. W. Daniels; "The Practical Aspect of Refrigeration, as applied to the Chemical Industry," by Leuig Chew; and "Electrical Automatic Refrigerators for Domestic Use," by Raymond J. Mitchell. All three entered into a mass of detail as a corollary to a paper on the general subject read at the Conference last year. Mr. Daniels dealt with refrigerating plant as a whole, touching upon those features to which the engineer in a chemical works can and should pay attention. The second paper entered into general constructional details—following a considerable amount of theory—of large-scale refrigerating apparatus, whilst the third paper outlined the construction of the smaller types of domestic refrigerating apparatus which have been sold in increasingly large numbers as the result of recent legislation affecting the use of preservatives in food.

The discussion on the papers brought up once more the oft-discussed subject of the nature of the knowledge of chemical engineers. It was stated by Dr. F. A. Wilcox that refrigerating plant is more often than not sold to users who know nothing whatever of the principles of refrigeration, whilst, on the other hand, the refrigeration engineers usually knew little of the principles of chemistry. He pleaded for the co-operation of the engineer and the chemist in the design of refrigerating plant. Professor J. W. Hinchley, on the other hand, as a responsible teacher of chemical engineering, reminded the meeting that the object of training in chemical engineering was to obtain the very result that Dr. Wilcox had in mind, and he claimed that the chemical engineer ought to know sufficient about refrigeration processes to prevent himself being fooled by any salesman of a refrigerating plant firm. It came out in the discussion that a series of investigations on refrigeration problems is to be carried out at Teddington by the Refrigeration Committee of the Department of Scientific and Industrial Research, one of the first steps in connection with which will be the correlation of the large amount of widely scattered information now available. Mr. Daniels, by the way, characterised much of this information as more misleading than reliable, and attention was also called to the fact that there are very few good books dealing with practical refrigeration problems.

Industrial Lighting.

"The Problem of Industrial Lighting, with Some Reference to the Chemical Industry," was the subject of the first paper at the final meeting of the Conference on Friday, December 9th. The author was Mr. W. J. Jones, of the Electric Lamp Manufacturers' Association. This paper dealt with matters which have been described in detail before other institutions during the past few years, although this was the first time that they had been brought to the notice of a body of chemical engineers. In general, the author enunciated the principles of good lighting and the effect of improved lighting upon output and accidents. In the very short discussion that followed, it was made clear that there are yet employers who have not fully understood what efficient lighting means, and some amusement was caused by a reading of the illumination in the meeting room of the Chemical Society by means of a portable instrument, which gave a figure of 0·5 foot-candle, a decidedly poor illumination, as many people had found out long before that, even without the aid of an instrument.

The next paper came from the staff of the British Launderers' Research Association, and described an ingenious apparatus for measuring, with sufficient accuracy for works purposes, the weight and volume of the contents of vessels, whether liquid or solid, or a mixture of liquid or solid. The authors were Messrs. R. G. Parker, D. N. Jackman, and J. N. Vowler. The instrument was primarily designed in connection with washing machines, but it is capable of other applications. It is called the "Weighmeter," and the principle adopted is that of the hydrostatic weighing machine. In such instruments the readings are taken by means of a pressure gauge, whose indicating hand moves over a scale graduated to read weight—not pressure—the variations in pressure being proportional to the variations in the load resting upon a plunger of fixed area which is, in turn, supported by the fluid under compression.

The final paper of the Conference was one on "The Properties of Silica and Fire-clay Products in Relation to their Industrial Usage." The author was Mr. A. T. Green, of the Derbyshire Silica Firebrick Company, Ltd., who, for fluency of expression and familiarity with his subject seems to have taken upon himself some of the characteristics of Dr. J. W. Mellor, with whom he worked for a time. This particular paper was purposely an introductory one to chemical engineers, and was prepared from the point of view that those to whom it was addressed were more or less unfamiliar with the subject. It followed, therefore, that the paper was general in character, and contained much that has been published elsewhere in one form or another, and can briefly be referred to as a review of the position as we know it to-day. The author pointed out that the technique of clay and silica products had progressed considerably during the past decade or so, but that hand in hand with the investigation of the fundamental properties must go the definition of the actual conditions obtaining in industrial usage. Up to the present, however, that phase of the work had not received much attention, although a greater realisation of its importance was becoming evident. The fact that many apparently superior products had failed in specific duties, whereas the so-called inferior material had given comparative success in the same field of usage, had emphasised the necessity for adequate definition of working conditions. It was evident, therefore, that refractory materials were not yet amenable to very definite specification, but that state of affairs must be overcome in the near future if the industry was accurately to meet its demands.

Pulverised Fuel on a Cargo Steamer.

For a summary of the position reached with regard to the use of pulverised fuel for marine purposes up to about the middle of the year, the reader may be referred to the paper which was read by Engineer-Captain J. C. Brand, R.A.N., at the summer meetings of the Institution of Naval Architects. That paper was reprinted in abstract form in THE ENGINEER of July 15th. In it Captain Brand discussed the question of the pulverising of fuel, its storage and transmission, and various methods of burning it in Scotch and water-tube boilers. In particular, an account was given of the experimental work which has been carried out by the Australian Naval Board.

In an appendix Captain Brand gave a summary of the progress made up till April, 1927, by Mr. C. E. Jefferson, of the Fuel Conservation Section of the United States Shipping Board, with tests on a Scotch boiler using for the earlier experiments the Fuller-Lehigh burner, and for later work the Peabody burner, which we describe below. In a paper which was read in New York last month at the 1927 meetings of the Society of American Naval Architects and Marine Engineers, Mr. C. E. Jefferson and Commander Joseph S. Evans, U.S.N., gave an illustrated description of the progress of work to date, which included figures for a 240-hour continuous service run. That run was made in five 48-hour trials following each other without interruption, during which combustion rates of 1200 lb., 1400 lb., 1600 lb., 1800 lb. and 2000 lb. of fuel per hour were maintained. In addition to this paper, full particulars were given at the same meetings by Mr. Thomas B. Stillman of a series of tests which were made at the Bayonne works of the Babcock and Wilcox Company on one of that firm's standard marine boilers fired with pulverised coa on the Fuller-Lehigh system.

Additional interest was created at the meetings referred to by the arrival in New York about the same time of the reconditioned and converted cargo steamer Mercer, which had steamed round from Baltimore burning pulverised coal. On November 23rd the Mercer left New York and berthed at Rotterdam on December 8th, having made the Atlantic crossing with cargo. The crossing was made in very heavy weather in 14 days 9 hours, at an average speed of 9·83 knots. The arrival of the Mercer has created great interest in both British and continental shipping circles, and invitations were extended by Captain P. C. Grening, the European director of the United States Shipping Board, to view the steamer. In what follows a brief description of the pulverised fuel installation aboard the Mercer is given.

The Ship and her Propelling Machinery.

The Mercer is a cargo steamer of 6190 gross tons measurement, with a deadweight carrying capacity of 9500 tons, and she has a length of 411ft. 6in. overall, with a moulded breadth of 55ft. and a depth of 31ft. 4in. She was built

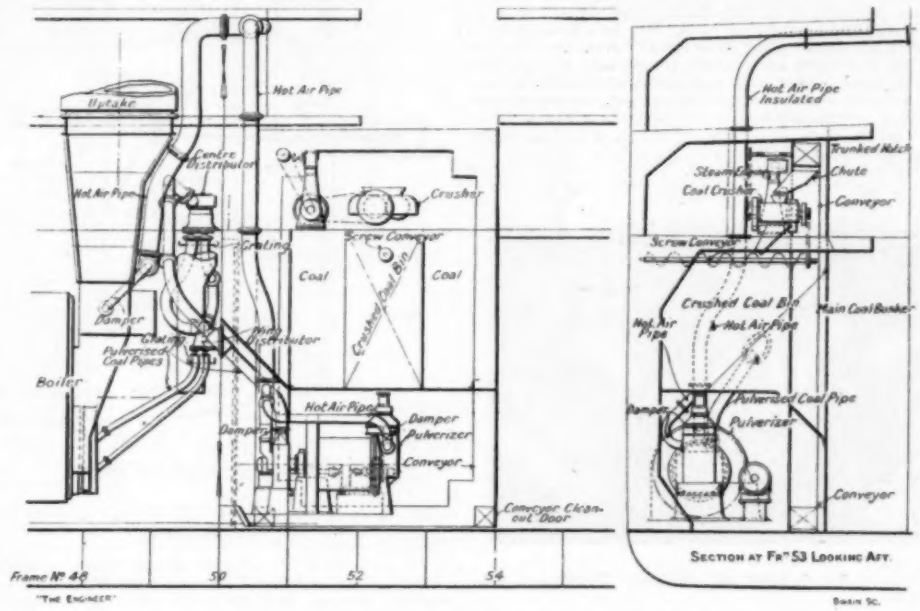


FIG. 1—ARRANGEMENT OF PULVERISED FUEL PLANT ON S.S. MERCER

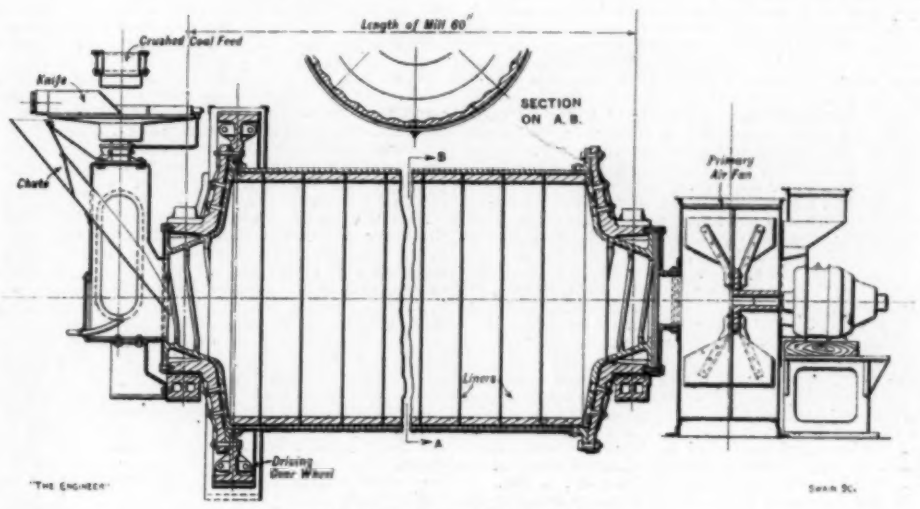


FIG. 2—SECTION THROUGH PULVERISER

at the yard of the Federal Shipbuilding and Dry Dock Company in 1919, and is equipped with steam turbine propelling machinery built by the General Electric Company, of Schenectady, and designed for an output of 2500 S.H.P. There are three flush-fronted Scotch marine boilers, each with three furnaces and designed for a working pressure of 210 lb. per square inch. Each boiler has a heating surface of 8934 square feet.

A general outline arranged of the pulverised fuel burning equipment which was fitted at the Baltimore yard of the Maryland Shipbuilding Company, is reproduced in Fig. 1. The grouping shown is to some extent diagrammatic, and a visit to the ship made it clear that a simplified

arrangement of pulverised fuel distribution pipes had been fitted for the voyage. It was early found that all the steam which was required for the turbines could be obtained from the two wing boilers, and the centre boiler was therefore cut out. This being so, each pulveriser, one of which is placed in each boiler-room wing space, was connected directly to a single distributor, which served the three furnaces of a single boiler. Otherwise the arrangement was substantially that which we show.

Forward of the boiler-room centre bulkhead there is the main coal bunker with its lower fore and after sides tapered inward so that very little trimming is necessary. The coal is delivered through a door on each side of the bottom of the bunker to the conveyor, which carries the lump coal to a platform above. The function of the coal crusher, which is fitted on the platform, is to break the delivered coal into small pieces with a maximum size of 1¼in. The crusher delivers broken coal into the ready-use bunkers which are fitted below it, and arranged so as to discharge their contents into the pulveriser feeds. It may be mentioned that it is only necessary to operate the crushing plant for one hour out of the twenty-four, that time being all that is required to fill the ready-use bunker.

The coal from the bunker referred to falls by gravity on to a flat disc at the bottom of the feeding hopper. Over this stationary disc there are a series of rotating knife arms, with a slight forward lead, which scrape off the coal and delivers it to the pulveriser.

Our illustration, Fig. 2, shows a section through one of the pulverisers, with the feeding mechanism at the top left corner. The pulveriser is of the Kennedy air-swept ball mill type, and was built by the Kennedy-Van Saun Manufacturing and Engineering Corporation of New York. It consists of two cylinders, the inner of which is in sections and is secured to the outer cylinder with an intermediate layer of insulating material to deaden the noise. The outer cylinder is also covered with wired hair felt and cork linoleum. As will be seen from the view given, the inner sections of the cylinder are corrugated in order to assist in the cascading of the ball charge, which consists of about 5000 lb. of Herculite steel balls. The mill is designed to run at a constant speed of about 34 r.p.m. At each end of the mill there are truncated inlet and outlet cones, which are furnished with square threaded leads, so that all material is fed into the mill and, on the other hand, there is no tendency for the ball charge or any large pieces of coal to leave it. Each pulveriser is turbine-driven through a speed reduction gear, and a main wheel attached to the outer cylinder of the mill. We have already referred to the motor-driven feeding disc, which may be used to

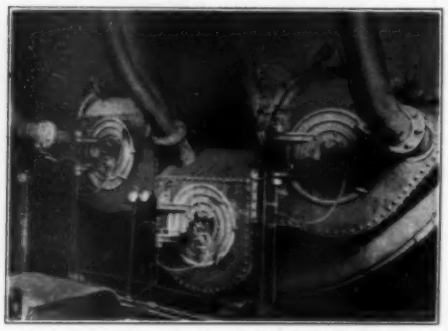


FIG. 3—VIEW OF FURNACE FRONT

control the supply of coal delivered to the mill by controlling the speed of the motor from a specially arranged panel.

There is an air box at the feed end of the mill, with two openings, one to the preheated air pipe which furnishes air for sweeping the mill, and the other for inspection purposes or for adding to the pulverising charge.

At the discharge end of the mill is the primary air fan, which was worked as a simplex fan; dampers are fitted to regulate the air supply to the mill. The finely pulverised fuel from the mill is taken, with its "carrier air," to the distributor, the function of which device is to divide the fuel charge into three streams of equal quantity and quality. During the trial runs made at the Philadelphia Naval Yard a motor driven distributor was employed, but as fitted in the ship a small steam turbine is used to work the rotary paddles which distribute the fuel charge to the burner registers. The fitting of a steam turbine necessitated some alterations in distributor design and some of the bearing trouble experienced was, we are given to understand, to be attributed to the particular bearing arrangement adopted.

In drawing, Fig. 4, we show a section through a typical Peabody pulverised fuel burner, arranged for oil and coal. This burner was the direct outcome of the Peabody-Fisher wide-range oil burner, which was later modified to burn natural gas and oil. The same air register was kept, giving the air supply a rotary motion, so that the gas entered through an annular opening within the throat of the burner. Practically the same arrangement is adopted for the coal burner, now built by the Peabody Engineering Corporation of New York. The coal-laden primary or "carrier" air enters a volute encircling the throat of the burner and issues through an annular opening. As the secondary air is also given a rotary motion, a very short flame is produced. It is found that combustion can be completed before the horseshoe end connection of the furnace flue is reached, while the length of the flame can be varied by adjustment from 4ft. to 10ft.

In the discussion which followed the reading of the New York papers, the fact was mentioned that the preliminary trial results at the Philadelphia Navy Yard showed that a heat release of 141,000 B.Th.U. per cubic foot per hour, corresponding to almost 10 lb. of coal per cubic foot, was attained; this figure being calculated on the volume of the furnace tube in which combustion was completed. That figure is, we are informed, some three and a half times the maximum heat release reported for any land station by the Prime Movers Committee of the National Electric Light Association of New York in a report dated August, 1927. That report covers returns from 71 central stations using the "central bin" system and 133 stations working on the "unit system." We digress to make this reference because the same kind of burner used on the Mercer would appear to be very useful for land work, in that it does not require a large and expensive combustion chamber or the enlargement of the existing furnace. A general view of a typical Peabody burner installation fitted to a flush-fronted marine type boiler is reproduced in Fig. 3. The arrangement shown is practically the same as that employed on the Mercer, and the simple grouping of the pipes may be seen. As shown in Fig. 4, the burner is so designed that either coal or oil can be used, and the change-over can be effected in a very short time by the operation of one or two valves.

TRIALS AND WORKING RESULTS.

After her run from Baltimore to New York, the Mercer was manœuvred into a crowded harbour using pulverised fuel only, with no lift of the safety valves and a variation in steam pressure of about 15 lb. The control of the supply of steam was carried out with complete ease by regulating the supply of coal to the pulverisers and the operation of coal valves in the connecting pipes to the burners. No attempt was made to measure the amount of coal burned, as much of the time was spent in demonstrating the operation of the different parts of the plant. For the

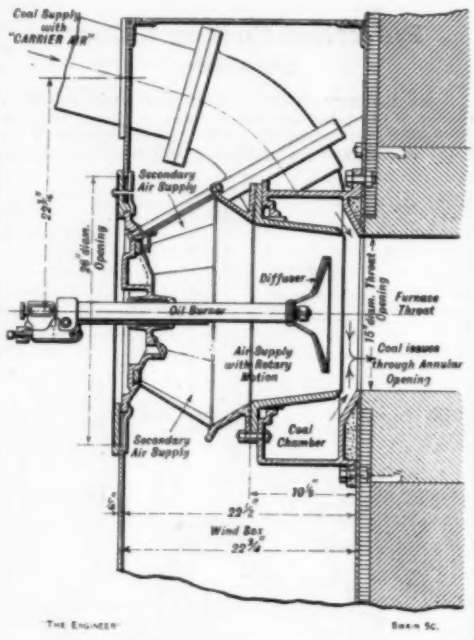


FIG. 4—SECTION THROUGH BURNER

same reason the burners were not always kept at the point of best adjustment, and combustion took place under varying conditions.

The crossing of the Atlantic on the outward voyage of the ship was made under distinctly difficult weather conditions. For ten days the vessel was in heavy weather, during which the wind reached gale strength, the ship rolling through about 36 deg. and pitching through about 12 deg. As regards the weather, the Mercer received a fairly severe test, and the propeller slip was estimated in the engine-room to reach at times to 26 per cent. for a period of 24 hours and gave a figure of 16 per cent. for the voyage. Nevertheless, the crossing was made in 14 days and 9 hours, and an average speed of 9·83 knots was maintained. The pulverised fuel burning equipment, which we have already described, worked excellently, and the only trouble experienced was of a mechanical character connected with the bearings on some of the newly designed moving parts of the equipment, which had only been tested for a few days before setting out for a continuous run of over two weeks' duration.

At no time was more than one boiler out of action, and that only occurred over very short periods. We understand that the voyage could quite well have been completed without using the oil burners at all. Since, however, the vessel was under charter, oil was utilised to maintain the scheduled speed against the weather during short periods of shut off on the pulverised fuel system while correcting mechanical troubles.

It is of interest to know that it sufficed to blow through the boiler tubes with the Diamond soot blower only once in a watch. Steam with a superheat of 40 deg. was used, and was found to clean the tubes and the retarders thoroughly. It also appears that it will not be necessary to draw the furnace tubes oftener than once a trip, which is usual with coal-fired ships. When the furnaces and uptakes were swept down after the ship had done 5000 miles, they were found to be no dirtier than would be expected with ordinary oil firing.

Some of the visitors to the ship at Rotterdam remarked on the dust which was plainly visible on parts of the vessel. We are informed that this was partly due to the low funnel, which is 20ft. shorter than those of sister ships. The coal was about 18s. a ton, and was 75 per cent. slack, and the fuel consumption was about 1·3 lb. per S.H.P. hour.

In conclusion, we would express to Mr. C. E. Jefferson, of the Fuel Conservation Section of the United States Shipping Board, and Commander J. S. Evans, U.S.N., who accompanied the ship to study the operation of the plant under actual service conditions, our congratulations on the unqualified success of a notable experiment. Those who are most familiar with the valuable preparatory work which was done prior to the fitting out of the Mercer are fully satisfied with the trip. Both Mr. C. J. Jefferson and Commander Evans are leaving the ship to be taken back by her crew, and are returning immediately to the United States to prepare plans for the conversion of some further ships for the Shipping Board merchant fleet. It is also interesting to learn that arrangements are well in hand for the construction of Peabody burners and equipment in Great Britain under the direction of Mr. J. W. M. Topley, of Sentinel House, Southampton-row, who is the British representative of the Peabody Engineering Corporation, New York, also that Kennedy pulverisers will be built in England, so that our own shipbuilders will be kept in closest touch with the future development of the system.

Canadian Engineering News.

(*From our own Correspondent.*)

An Aerial Survey for a Transmission Line.

A NEW departure in transmission line construction in Canada is the employment of aerial mapping for survey purposes. This method was used recently in connection with the survey for the Ontario Hydro-electric Power Commission's 220,000-volt transmission line between Ottawa and Toronto, a distance of some 200 miles. A speedy seaplane was successfully used in locating easements for the line. An aerial survey was considered and adopted, as against a preliminary field survey, as being both cheaper and quicker, and at the same time giving assurance of the best possible location of line. To obtain as straight and as short a line as possible for the eastern 120 miles of line through rough, undrained lake district, and a straight, short, easily constructed line, missing villages, farms, buildings and orchards, for the western 80 miles, were the two problems facing the Hydro engineers. The first procedure in laying out the line was to project and locate the general route. Practically the only maps available were the township maps and the standard Government topographical maps, 3·95 miles to the inch. Cases were found later, by the aerial photograph, where lakes were half a mile from their map location. A great many lakes were not mapped at all, and certain roads on the maps did not exist.

The aerial survey company which undertook the work was given a copy of the Government map showing the projected centre line, and two sets of oblique photographs were taken, one from either side. These photographs were used to locate or revise the line with sufficient finality to allow vertical photographs to be taken over the final location. The vertical photographs were taken at a height of approximately 6000ft. over what was now fixed as the approximate final location of the line, and were then made into matched mosaics in strips about 22in. long, showing in great detail a strip of country averaging 1¼ mile in width. By the use of the aerial maps, the Hydro Commission's right-of-way agents were able to go out into the field and secure options or easements without any preliminary field work.

A New Railway.

The Minerals Separation Corporation, otherwise known as the Whitney interests of New York, has decided to exercise its option on the famous Flin Flon Mine, in the province of Manitoba, which means an expenditure of upwards of 40,000,000 dollars in that area. The Whitney interests have entered into an agreement with the Federal and Manitoba Governments, which calls for the immediate construction of a branch line of the Canadian National Railways from the Hudson Bay Railway at The Pas, to the company's property, a distance of 84 miles. In order to make immediate construction possible, the Manitoba Government has agreed to meet all deficits on this road up to 100,000 dollars per annum for a period of five years. The Whitney interests also have put up a cash subsidy of 250,000 dollars. The railway will be built by a subsidiary syndicate of the Canadian National Railway for the Canadian National, and when it is completed it will be taken over by the latter corporation. It has been estimated that it will cost approximately 3,500,000 dollars. The general scheme also involves the development of a big water power station at White Mud Falls on the Nelson River, and the erection of a great smelting plant with a capacity of 3000 tons of ore per day. In addition, it means the creation of a new town of not less than 5000 people on the Manitoba–Saskatchewan border.

SPEAKING at a dinner on the evening of November 29th, Mr. Frank Pick, the deputy managing director of the Underground Railways, said that the greatest loss to the city day by day was that which resulted from delay and congestion on the streets. The London General Omnibus Company lost in actual out-of-pocket expenses a million pounds a year through that cause. If it could run its omnibuses as scheduled, it would be that amount better off at the end of the year.

THE Clogher Valley Railway is an Irish line, 37 miles long, built under the Tramway and Public Companies Act, 1883, and opened in 1887. At the time of the Scotter Vice-regal Commission, it was being worked at a loss so that the maximum contribution payable by the Treasury had to be forthcoming. Certain baronies of Tyrone had to pay 11d. in the £ and in Fermanagh 7d. in the £. Matters are now very much worse, and the assessments are 1s. 6d. in the £ and 1s. respectively. A committee of investigation was recently appointed by the Government of Northern Ireland to inquire and report what should be done. That body has just reported and recommends that the passenger-carrying portion of the railway's operations should be discontinued in view of the motor omnibus services now available, and that the administration of the line should be reorganised on the basis of goods-carrying traffic only. Staff reductions would effect a saving of £7118 per annum, and the saving in locomotive fuel would be £1600, while other expenditure could be reduced by £1800, a total saving of £10,518. The loss of passenger receipts would amount approximately to £3000 per annum, but the net benefit would be a little over £7000 per annum, and that sum would extinguish the present working loss of £6366, and leave a small profit available to meet the annual contribution to the renewal fund.

Recent Progress in the Methods of City Refuse Collection and Disposal.

By JOHN B. C. KERSHAW, F.I.C.

No. II.*

LONDON: ST. MARYLEBONE.

A new type of destructor, so far as this country is concerned, has been erected in Paddington, by the St. Marylebone District Council. This destructor is of the vertical shaft type, was designed by the Woodall-Duckham Vertical Retort Construction Company, and was put into operation in August, 1926. It is illustrated in Fig. 1, from which it will be seen that it consists of a water-jacketed cylindrical shell provided with a charging hopper above and with a clinker cutting apparatus below. The destructor is operated with the aid of forced draught, and the combustion gases are led directly to a water-tube boiler provided with an exceptionally large combustion chamber, and with collecting hoppers for the dust. An induced draught fan is also provided at the foot of the chimney in order that a high speed of the gases may be maintained over and through the boiler tubes. The refuse is fed into the destructor through a sealed charging door at regular intervals, and the clinker which forms in the lower part of the furnace is removed frequently by the aid of a knife constructed of special steel. The severed block of clinker then falls into a tip wagon which runs on rails below the destructor. The clinker when cut is in a semi-plastic state, since it has been subjected to the cooling action of the water in the jacket which surrounds the lower part of the destructor furnace. The cutting knife is therefore not subjected to any degree of heat that would destroy its edge, and the whole operation of cutting off and discharging blocks of clinker only lasts about half a minute.

The water supply to the jacket of the destructor is kept in circulation by a small rotary pump, and after passing through the jacket it is employed either to feed the economiser or is passed directly into the boiler, and in that way the heat recovered from the clinker is utilised in the generation of steam. The temperature attained during the combustion of the refuse rises to between 1400 deg. Cent. and 1500 deg. Cent. as the result of the use of the blower, and this prevents the production of any objectionable odours. The gases pass away from the destructor with a temperature of 1000 deg. Cent. to 1200 deg. Cent. and can be utilised for steam raising in any type of water-tube boiler, if equipped with two or three banks of tubes and a setting specially designed for easy removal of the dust which is carried into the combustion chamber from the destructor. At Paddington a primary dust chamber provided with a hopper is arranged below the first bank of water tubes, and a second dust chamber, with another hopper discharge, is placed below the boiler drums. Soot blowers are employed to free the tubes from dust at regular intervals, and in that way the efficiency of the boiler is kept at a high figure. The destructor has been designed for dealing with 1 ton of refuse per hour, or 24 tons per day, and it was estimated that it would be possible to generate between 150 and 200 kW of electric power with the steam raised in the boiler attached to the destructor.

The issue of the *Fuel Economist* of June, 1927, contains a copy of a report by Mr. F. H. Brunt, giving the results of a test made of the steam-raising capacity of this plant, during which 413 tons of refuse were consumed and an evaporation of 3217 lb. of water per hour was attained. This is equivalent to 4362 lb. from and at 212 deg. Fah. No figures are given for the power actually generated, but on the assumption that at 156 lb. pressure 17 lb. of steam would suffice to generate 1 kW hour, the steam production of the boiler was equivalent to 189 kW. The generating plant at Paddington is a Lindley enclosed vertical double-acting engine, coupled to a continuous-current generator of 200 kW capacity, which, when running at 426 r.p.m., generates 900 amps. at 225 volts. During the test referred to above the destructor dealt with 29½ tons per day, or 5·45 tons per square foot of grate area per 24-hour day, which is a very high rate for destructor work and proves what can be achieved with the aid of forced draught.

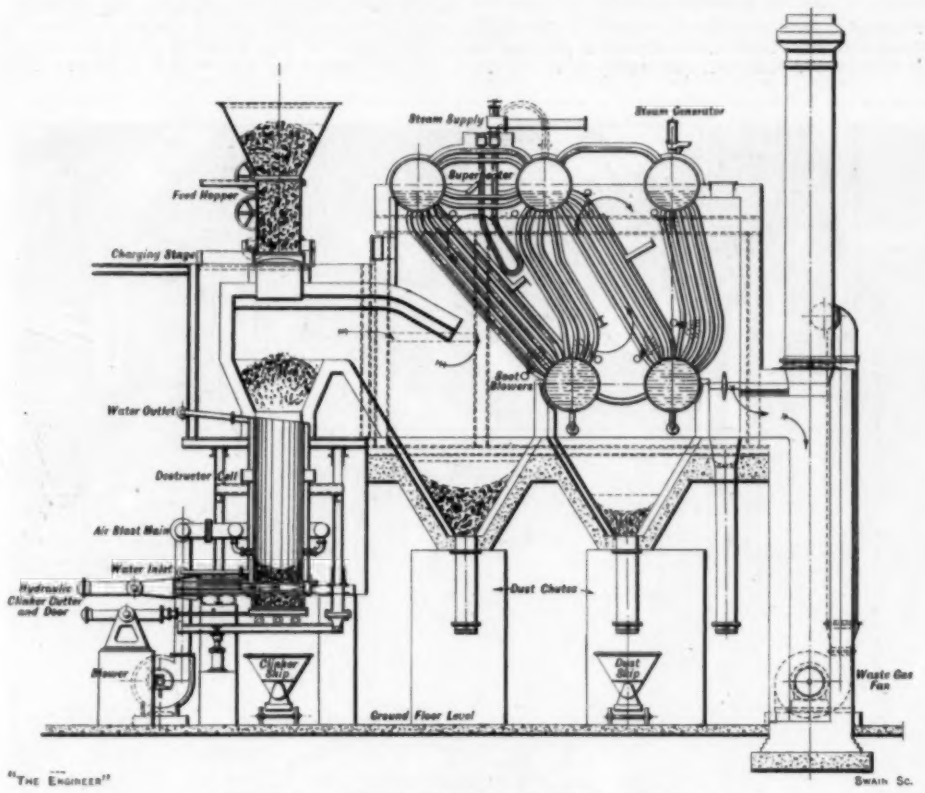


FIG. 1—WOODALL-DUCKHAM VERTICAL RETORT DESTRUCTOR

FIG. 2—LOADED REFUSE WAGON READY TO BE LOWERED ON TO CHASSIS

LONDON: WESTMINSTER.

The Westminster City Council has erected at Ebury Bridge-road a new salvage plant, specially designed by the Coppée Company of Great Britain for recovering from the house refuse collected in this district all the components that have a commercial value and can be disposed of to yield a profit. This plant has a capacity of 100 tons of refuse per twenty-four hours, and was opened in 1923. The methods used for transporting and sorting the refuse and for recovery of all the salvable materials are very similar to those which have been already described as in operation in Birmingham, and the illustrations of the Westminster plant given in Fig. 3 are self-explanatory and do not require further comment.

One special feature which is found at Westminster alone, however, may be described in detail, and that is the washery, by which the coke and other combustible matter is separated from the coarser refuse left on the picking belts. These washers are the well-known Coppée type, and the material before passing through them is graded into three sizes by a rotary screen. Each class of material is treated separately in the washers, which are the pulsating type, the lighter combustible matter being carried away by water flotation into draining hoppers, while the heavier incombustible matter collects in the lower part of the washing chamber and is removed continuously by a bucket elevator and collected in a draining bunker. The recovered coke and other combustible matter from the washery is sold, and the plant differs therefore from those previously described in the fact that the electric power required for operating it is purchased, and is not generated on the spot.

The non-combustible portion of the refuse is passed through a pulveriser of the swing-hammer type, driven at a speed of 1000 r.p.m. This reduces the whole of the material to a state of fine powder, which after being mixed with the dust that is obtained during the first screening of the refuse, is bagged and sold as a manure. Recently another type of fuel separator has been tried at this works for separating coal, coke and similar combustible substances from earthy and vegetable matter. This type of refuse is stored in the open for a period of three months in order to allow the vegetable matter to rot, and it is then passed into a hopper which feeds a paddle type of fan. The refuse is delivered by this fan at an angle of about 35 deg. on to a revolving cast iron circular plate, which is running horizontally in a direction opposite to that of the feed from the fan. On striking this plate the cinders, coke, &c., bounce straight off into a jig screen, which grades them into various sizes, while the vegetable matter takes a different course, owing to the fact that it adheres for a moment to the surface of the plate. The refuse by this system of treatment is therefore separated by one operation into three classes of material, the larger pieces of coke and cinders being delivered out of one end of the jig screen, the smaller combustible material passing through the mesh of the screen, and the vegetable matter being collected at a third point of discharge.

LONDON: WOOLWICH.

A new electric generating station has been put into operation recently in the Metropolitan Borough of Woolwich, and it has necessitated closing down one of the older types of combined refuse destructor and generating station, which had been in operation in Woolwich for over twenty years. Mr. J. Sutcliffe, the engineer of the Woolwich plant, therefore decided to erect and operate a plant for the manufacture of clinker asphalt, with the surplus heat and power at the old works, and a special self-contained plant was designed for the new manufacture. The new works

* No. I. appeared December 9th.

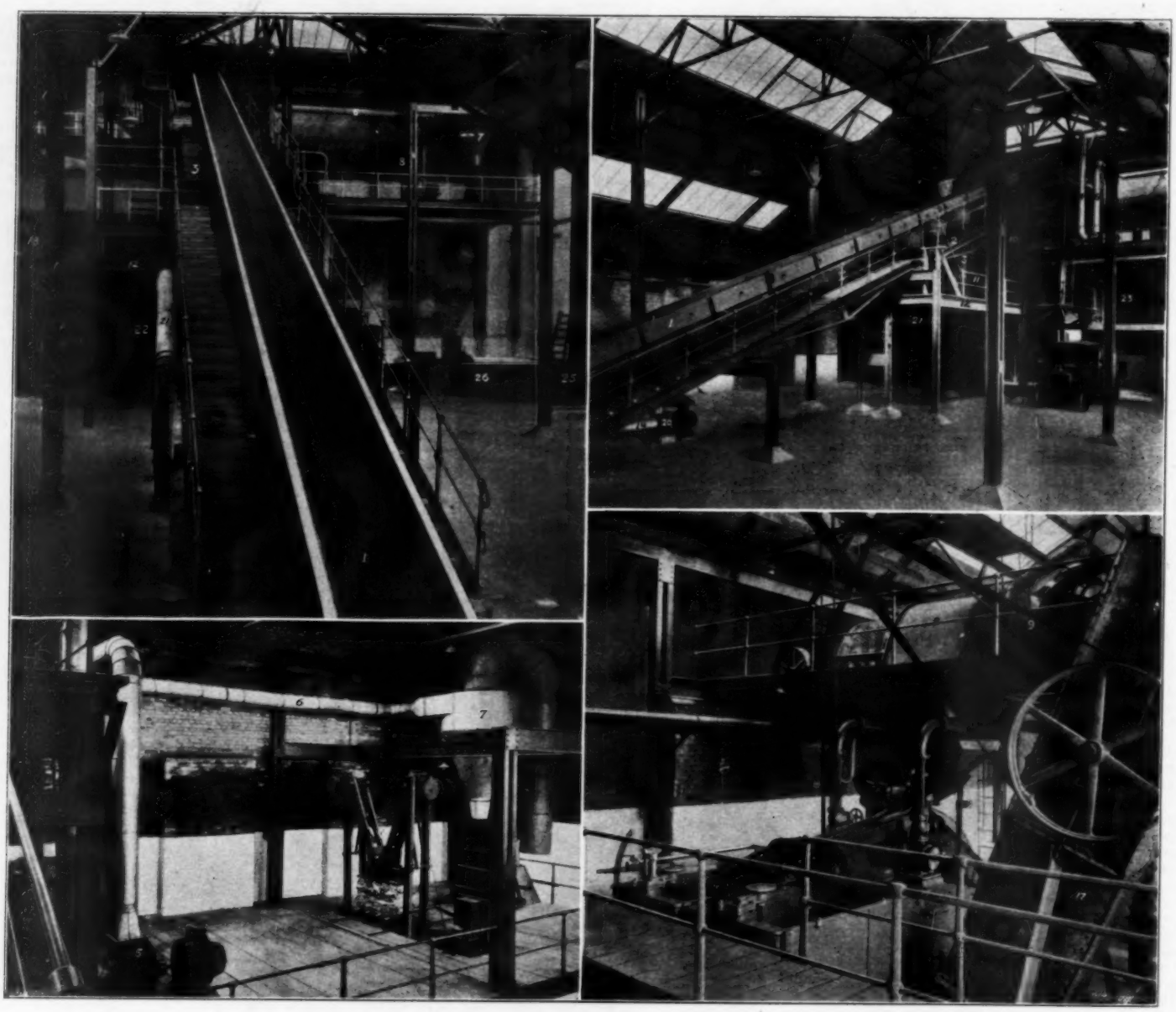
comprises grinding, separating, elevating, storing, heating, weighing and mixing machinery, and the operations so far as possible are carried out automatically, the material never being seen after it leaves the magnetic separator until it is ready for distribution in the form of asphalt. This is produced from a mixed aggregate of well-crushed and graded clinker with bitumen or with some other suitable binding material, and has been employed for a considerable time for the making and surfacing of all the main and by-roads in Woolwich and neighbourhood with marked success.

The clinker is brought over from the destructor furnaces to the asphalt plant while still hot, and is first ground and is then passed over electro-magnetic separators, in order to remove iron and other magnetic material. The crushed clinker is next passed over adjustable screens by which it can be graded into various sizes from ¼in. to ⅝in., and the graded material is then stored in hoppers having a combined capacity of 70 tons. The next stage in the manufacture is to heat this crushed material before its admixture with the bitumen, and this is carried out in a patented form of rotary heater, in which the greatest amount of surface of the crushed clinker is exposed by means of deflecting vanes to hot gases from the destructor furnaces and boilers. The heated clinker, after passing through the heater, is discharged into the weighing bin, which feeds the mixers, and when the required weight has been attained the bin is automatically discharged into the paddle mixer, which is placed immediately below it. At the same moment the necessary amount of bitumen is discharged from a measuring tank placed alongside the weighing bin, and the clinker and bitumen are very thoroughly incorporated before their discharge into a steam-jacketed hopper kept at a temperature of from 400 deg. to 500 deg. Fah. by means of superheated steam. As it is practicable to transport the asphalt in 5-ton loads with a drop in temperature of only 1 deg. to 1½ deg. Fah. per mile, it is possible to supply an effective area of 40 to 50 miles with the asphalt produced at the Woolwich plant, and in the year 1924–25 4638 tons of clinker obtained from the Woolwich destructor were applied to the upkeep of the roads in the district.

SHEFFIELD.

Sheffield is another of the cities in which electrically propelled vehicles have been adopted in place of the petrol motor for collection and transport of the city refuse to the destructor plant, and the latest works which has been erected and equipped at a cost of £220,000 is provided with a garage and charging equipment for the seventy-five electric collecting wagons employed for the transport of the refuse. The plant installed at this new works has a capacity of 500 tons of dry refuse per day, and the refuse when it arrives is discharged into a large bunker capable of holding one day's collection. The material is removed from this bunker by Priestman grabs operated by electric cranes, and is delivered into hoppers which feed ten rotary screens. These separate the refuse into four classes of material, namely, (*a*) dust passing through a ¼in. mesh; (*b*) fine cinders between ¼in. and ½in.; (*c*) coarse cinders between ½in. and 2½in.; (*d*) tailings which are passed on to the picking belts. The rate at which the refuse is delivered to the rotary screens can be regulated by altering the speed of the conveyor.

The dust which forms the first class of material is a useful fertiliser, and large quantities of it have been supplied to farmers in the districts round Sheffield. The second class of material, comprising the finer cinders between ¼in. and ½in. finds a ready market as a fuel, and is either burned in a special type of furnace or is converted into briquettes for domestic use. The coarser cinder which ranges from ½in. to 2½in. in diameter is washed, and the heavy incombustible matter is extracted, and is passed to the dump, while the combustible portion of this material is burned on underfeed stokers for the generation of steam in the Stirling type of water-tube boiler. The power house at this works is equipped with three 250 kW generating sets, which produce sufficient current to run all the machinery, and also to charge the batteries of the electric motors employed for transporting the refuse to the works. No coal is purchased and the boilers are run entirely upon the fuel extracted from the refuse.



1. Combined Elevating and Picking Belt from Unloading Hopper to Revolving Screen.
2. Picking Platform.
3. Shoots for Hand-picked Materials.
4. Suction Main for Paper Extraction.
5. Motor-driven Fan for Paper Extraction.
6. Delivery Main for Paper Extraction.
7. Cyclone Settler for Paper Extraction.
8. Press for Paper Baling.
9. Magnetic Drum for Removal of Tins, &c.
10. Shoot from Magnetic Drums to Baling Press.
11. Baling Press for Tins, &c.
12. Loading Platform for Hand-picked Materials and Bales from Press.
13. Revolving Screen dividing into (*a*) Small Cinders, (*b*) Large Cinders, (*c*) Oversize.
14. Washer for Small Cinders.
15. Washer for Large Cinders.
16. Shoot for "Oversize" to Pulveriser.
17. Draining Elevator for "Discard" from Washers.
18. Loading Bunkers for Washed Large and Small Cinders and "Discard" from Washers.
19. Suction Main for Collecting Dust at Inloading Hopper.
20. Fan for Collecting Dust at Inloading Hopper.
21. Delivery Main for Collecting Dust at Inloading Hopper.
22. Dust Settler and Air Filter.
23. Pulveriser for "Oversize" Material.
24. By-pass Shoot for Loading "Oversize" Material Direct from Screens.
25. Water Circulating Pump for the Washers.
26. Decantation Basins for Clarifying the Circulating Water.

FIG. 3—THE REFUSE TREATMENT PLANT OF THE CITY OF WESTMINSTER

	1925. £
Fuel	3,967
Tins	3,200
Fish manure	1,473
Miscellaneous	679
Mortar and clinker	570
Fat	501
Meat and bone meal	300
Paper	145
Other fertilisers	124
Rags	113
Total	£11,072

An income of about 2s. 6d. per ton is obtained from the various materials recovered from the tailings. The old tins are baled and supplied to steel makers, bones are de-greased and after grinding are sold as "bone manure," while the rags are washed and sterilised and are sold with the paper to paper manufacturers. The figures in the foregoing table give the receipts from these various sources for the year ending March 31st, 1925.

SOUTHPORT.

The system of refuse disposal at Southport was altered in the year 1914 and is now that of dumping the refuse on the low-lying area of land situated on the estuary of the river Ribble. Before that date the ordinary method of destruction by incineration had been in use, and the adoption of a dumping system may be regarded by some engineers as a retrograde step. In cases where derelict land can be reclaimed, however, and rendered available for building purposes there is a good case for this system of disposal, and at Southport a considerable amount of land has been already recovered from the tidal estuary of the Ribble by the methods which are now in use. The reclaimed land, after filling up with the waste material, is first planted with sods of rough marsh grass and after a year or two the land is put to agricultural use.

The other special feature of the Southport method of refuse disposal, namely, the use of a combined system of horse and petrol wagons for transport of the refuse, has been already alluded to, but some further details of the method may be given here. It is known as the "container" system of refuse collection and has been gradually brought into use in Southport since 1915. Before that year Southport was one

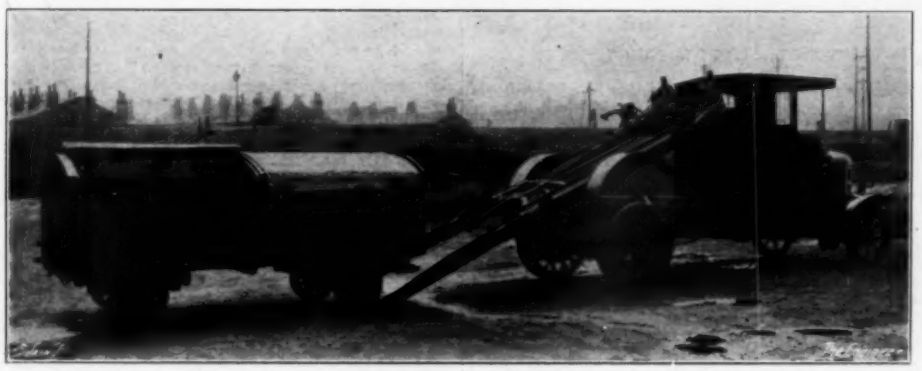


FIG. 4—REFUSE COLLECTING WAGON AND ITS CONVEYING LORRY

of the most heavily rated towns as regards the cost of refuse collection and disposal, for the town covers an area 8½ miles in length by 2 miles in depth and the density of population is one of the lowest in the country, there being only an average of 5·6 houses per acre. Even the working-class houses are nearly all semi-detached, with good gardens either in the front or in the rear, and the town may certainly claim to be the original "Garden City."

Fig. 4 illustrates the method of hauling the low-sided collecting wagon, which holds 3 tons of refuse, on to the motor lorry, and Fig. 2 shows the wagon ready to be lowered on to the lorry chassis to go to the dump. The lorries used are of the Pagefield standard type, with a 4–5-ton chassis, modified and strengthened to render it suitable for the special nature of the work. The petrol engine is of the four-cylinder type developing 38 to 40 H.P. The hauling and tipping gear is driven by the engine through enclosed gearing and is automatically controlled. The "container" is hauled on to, and is lowered from, the lift frame by two wire ropes which are operated by a winch carried at the front end of the frame. This winch is also driven by the engine through the gear-box of the wagon. The control of the hoisting and lowering of the container is effected by a hand lever placed in a convenient position and controlled automatically, so that when the "container" is in its correct position on the lifting frame the power is cut off from the winch and the mechanism comes to rest.

RECENT PATENTS AND IMPROVEMENTS

Monsieur A. Bigot, in recent issues of the two French journals *Chimie et Industrie* and *Comptes Rendus*, has given a detailed description of the methods of garbage collection and treatment now employed in the French capital, and has urged the adoption of more rational and complete methods of utilisation. He recommends that the preliminary sorting of the refuse should be dispensed with, since it involves considerable risks of infection for the workers, and he suggests, therefore, that the refuse should be first dried and sterilised by passing through a tunnel kiln heated to 150 deg. Cent. by waste gases from the furnaces. He states that this dried refuse has a calorific value of 1500 calories, and that the clinker obtained after its combustion in the usual form of destructor furnace can be employed for the manufacture of bricks and different varieties of glass. The clinker, however, requires to be cooled in air and crushed or pulverised before being applied in this way, and all metallic substances must be removed by aid of magnetic separators, &c. By the addition of different fusion materials different types of glass can be produced. The acid glasses produce good bottles and electric insulators, whilst the basic glasses can be employed for the manufacture of building and paving blocks, since they are more vitreous and heat-resistant. The glasses containing 40 to 50 per cent. of lime, after granulation by water and pulverising, can be employed for the manufacture of slag cement.

Mr. A. Grote, in an English patent No. 244,358 of 1925, has dealt with the same subject and described the use of the silicious material separated from town refuse after screening, for the manufacture of glass. This material is first sintered by heat and is then charged into the glass melting furnace with the clinker produced by the destructor furnaces. Suitable amounts of substances containing silica such as quartz, sand, fire-brick, and of saline substances, such as potash, soda, or Glaubers' salt, are added in order to produce a mixture suitable for glass manufacture. Red lead can be employed as a softening agent and colouring agents, such as the oxides of cobalt, copper, iron, chromium, and uranium, may be added in order to produce glass of various colours.

Messrs. Laurin and Smith, two American engineers, have patented a new method of extracting the fat and grease from garbage, which is claimed to be more economical to operate than the present methods of extraction and also to eliminate all objectionable odours. Their process is based upon treatment of the dry refuse with naphtha, and upon the recovery of this extraction agent for use again and again. It is claimed that about 25 per cent. more grease is recovered by this method than by those now in use, and that the residue which remains in the extractor can be more readily ground for sale as a fertiliser. As Mr. Smith, one of the patentees, is superintendent of the municipal garbage plant at Cleveland, U.S.A., the process is receiving experimental trial at those works.

Mr. K. Gerson, in British patent 247,284 of November, 1924, has described a method of treating household and street waste for the production of a material which he terms "garbage wool," useful for the manufacture of paper and pasteboard and for other purposes. The refuse is first separated from all metallic material and ashes and is then fed without any previous drying into a beating mill, which converts the fibrous constituents into a fluffy mass. The mill at the same time reduces the non-fibrous constituents to a state of powder, which must be separated from the garbage wool before the latter is employed for papermaking or any other purpose. This separation is best effected by suspension of the pulverised product in water.

Mr. G. E. Heyl, in two British patents No. 251,558 of 1925 and No. 259,503 of 1926, describes a method of utilising town refuse for the manufacture of cement. The refuse is first dried by waste heat and is then ground and mixed with other ingredients, such as lime or bauxite, which will form a cement-making mixture with the ash of the refuse, when this is burned in the ordinary form of rotary cement kiln. The temperature employed must not exceed the fusion temperature of the ash, and waste gases from other heating furnaces can be employed for this purpose.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE PROGRESS DEPARTMENT AND PAYMENT BY RESULTS.

SIR,—In almost every branch of engineering to-day, there is a payment by results scheme operating in one form or another. Sometimes it takes the form of an authentic piecework or premium bonus system, whereby the individual worker receives additional remuneration for time saved on the operation, and at other times it takes the form of a collective bonus system, whereby the workers collectively participate in a bonus accruing from output in excess of a predetermined figure. In some factories each worker is allotted a given unit of work, to be completed in a given time, the wage rate being standard, but generally higher than that usually associated with the work in question, while in other factories a definite output is aimed at, the various foremen being responsible for exploiting the ability and capacity of every worker.

Whatever form the system takes, the object is to increase the productivity of the workers, thus ensuring bigger output at relatively lower costs, and one of the principal factors is the abolition of idle time. In days past it was frequently asserted that the high cost of production was not so much in actual manufacture, as in the time wasted between operations, and it was largely because of this that the progress department came into prominence. In those days manufacturing operations were somewhat loosely devised, and it was no uncommon thing for different phases of one operation on one piece to be handled by two, and sometimes three, operators. This led to long periods of idleness on the part of someone, either because the right operator was not available, or the right job was not available for the operator. The progress chaser was introduced to minimise these delays, and in so doing he materially reduced production costs.

With present-day methods of operation planning, however, the unwieldy operation is cut right out, and in its place are two or three distinct operations, which enable manufacture to proceed step by step until the finished component emerges. It is this which enables the management to formulate a system of payment by results, because every operation can be accurately priced or timed, and made to fit in with the general scheme of things. But it will be appreciated that the greater number of operations there are on any one piece, the greater number of intervals there are between operations, and, unless these are adequately controlled, the time gained on actual manufacture will be lost during the "between periods."

Again, any system of payment by results depends for its success upon a continuous flow of work, so that there is no waiting period for the operator. Immediately one job is completed, another must be available, if not, one of two things must happen. Either the operator must bear the loss occasioned by the delay, by booking excessive time against one of his jobs, or he must be recompensed by the issue of a waiting order, which is a direct charge against the organisation. In either case the firm suffers a loss, which is likely to prove considerable at the end of twelve months, and it will be seen therefore that it is of no use speeding up actual manufacturing operations, unless production as a whole is speeded up.

Production covers much more than actual manufacture—it covers issues, movements, inspection, and clerical matters. No matter how much production is narrowed down, even to a single manufacturing operation, these factors are involved, for manufacture cannot be commenced until orders and instructions are issued, and the material is received, while the resulting product is of no productive value until it has been inspected and removed to where it can be made use of. And this suggests that the progress department has a big share in production, for movement is a prime necessity, and progress, after all, is merely another word for movement, though with the qualification—forward.

The speeding up of manufacture by means of a payment by results system throws extra responsibilities upon the progress department, necessitating a corresponding speeding up there. With shorter spells of actual manufacture and more frequent intervals between operations, it follows that the task of feeding and removing is intensified; the utmost watchfulness is necessary, because the slightest delay will adversely affect the entire mechanism of the system. But the aim of the progress department is not merely to follow up, but to get ahead; it is not enough that it should guard against delay, but it must actually expedite manufacture.

There are many who contend that it cannot achieve this; that its function is to expedite production by guarding against delay, and ensuring that all operators are adequately fed. The writer's experience, however, is that, once the progress department can get ahead, it can influence manufacture to a marked degree, and especially when the individual operator has an incentive to extend himself, provided by a bonus or piecework system. The average operator hates actual idleness, and if he cannot see what is ahead he will slow down, with a view to minimising the period of idleness which may follow the completion of the job in hand. If he can see a job ahead, he is encouraged to speed up, and, if after a long period he has never had to complain of a delay, he is encouraged to extend himself still more, and his hourly productivity increases. All this, however, can be accomplished by following up, but it is when the progress department gets ahead of manufacturing requirements that the effect is more marked.

Directly it is apparent that there is more work in a department than can be handled, there is a determination on the part of everyone concerned to increase capacity, and this is particularly so when the progress department raises the standard of requirement, and repeatedly calls for more. The foreman is keen to meet the requirement, and seeks to devise new manufacturing methods with this end in view, while he is ably backed by the individual operators. When there is work, and plenty of work, productivity goes up by leaps and bounds; it is only when there is little work that enthusiasm flags, and a steady jog-trot is maintained.

For once the progress department has got ahead, it must keep there, for it is fatal to the enterprise if, after a period of plenitude which has taxed capacity and called for increased effort, it is followed by a slump. It has to be remembered that improvement in personal endeavour, like improvement in facilities, is permanent and not temporary; one cannot adjust one's capacity for just a passing phase, to return to normal when the phase has passed. One must either remain stationary or go forward; there can be no zigzag, or forward and backward movement.

So, the more the progress department expedites manufacture, the more will its responsibilities increase, and, in exploiting payment by results, it gains allies who are whole-hearted in their support, because they are mercenaries. They are none the worse for being so, because the labourer is worthy of his hire, and he who produces most should receive most. But, when jam is added to the menu, it must remain there; plain bread and butter is acceptable when nothing else is obtainable, but, once this is reinforced with jam, bread and butter alone is not sufficient. In other words, if a man has got used to earning £8 a week, he regards this as his standard weekly earnings, and he will not be satisfied with less, even though he does not have to work so hard for it; he is like the horse, he does not object to pulling forward, even with a heavy load, but he does dislike backing.

These allies are prepared to do their bit, so long as they are amply recompensed, and it is for the management therefore to use every legitimate means for exploiting them. The word "exploit" has come to have a sinister meaning in some sections of industry—taking an unfair advantage—but the writer prefers

the definition "to use the object to advantage," the advantage accruing to the object as well as to the user. And no man minds being exploited, if the result is to put money into his pocket.

Some firms complain that, in spite of a payment by results system, they cannot ensure really economical production because the rates are too high; some workers complain that they cannot make bonus, because the rates are too low. A fluctuating flow of work is the trouble in both cases, and the remedy is to maintain an even flow of work, at all times in excess of the immediate requirement. Plenty of work means no gaps of idleness, which are unproductive to the firm and the worker alike, yet have to be paid for, and if there are no gaps, rates can be fixed at an economic figure, from the standpoint of both parties. Where employment is intermittent, wage rates rule high, because they only operate at intervals, but where employment is continuous, lower rates rule, because in the aggregate they come out better. Much of the high rate is sheer waste, because it includes the idle periods, and it therefore subsidises idleness. It is not so much a high rate, as a high wage, that the worker wants, and the latter can best be accomplished on a low rate with continuity of employment, than on a high rate where the periods of employment are interspersed with intervals of idleness. W. J. HISCOX.

December 9th.

OXYGEN SUPPLIES.

SIR,—The interest taken by all branches of engineering in the supply and use of oxygen gas prompts me to offer some criticism on the method at present being advocated for distributing oxygen in a liquid state instead of by the existing method of distributing the gas in steel cylinders at 120 to 150 atmospheres pressure.

To commence with, I may say there is nothing new in the idea of distributing the liquid and allowing it to gasify under control on the premises where the gas is to be used, and the possibilities of this system for general use have been closely studied for many years by those interested in the oxygen industry, but I have recently had placed before me a lengthy document from a German source setting forth such extravagant claims for the economy of this system—viz., for transporting oxygen in a liquid state—that I think financial or engineering concerns not very conversant with the technicalities of this special subject might jump to the conclusion that this "new" idea was going to revolutionise the present system.

The chief advantages claimed in this German project are:—

(A) That by taking the liquid at one point in large quantities it can be produced and distributed much more cheaply than if made at several smaller local stations in the gaseous form.

(B) That by this method high-pressure steel cylinders can be done away with, which item forms a very large capital outlay for oxygen producing firms, and adds considerably to the cost of the delivered gas owing to the fact—according to the German statement—that the cylinders are 90 per cent. dead weight and 10 per cent. productive weight, whereas with the liquid system the dead weight is 20 per cent. and the productive weight 80 per cent.

While theoretically these claims are substantially correct, in actual practice there are many difficulties which would do away with the theoretical advantages claimed for this system.

Taking claim (B) first, 1 cubic foot of liquid oxygen is equal to 800 cubic feet of gaseous oxygen at atmospheric pressure, but as the gas in this country is compressed into steel bottles at 120 atmospheres pressure it actually occupies only 6·6 times the space taken up by the liquid. Assuming, therefore, 1 cubic foot of liquid oxygen to be in a single container and the corresponding 800 cubic feet of free gas to be compressed into trade bottles, the difference in weight between the container full of liquid and the bottles full of gas may be taken roughly as being in the same proportion as the difference in the space occupied. It might appear to anyone not conversant with the physical properties of liquid oxygen that the distribution of oxygen should be much cheaper as a liquid than as a gas, but when it is understood that in order to retain the gas in its liquid condition its temperature must be maintained below minus 183 deg. Cent., it is obvious that the problem is very much more complicated than when transporting liquids that are unaffected by ordinary atmospheric temperatures.

Liquid oxygen is at present only economically transportable in what are known as double-walled vacuum containers, the upkeep of which is considerable in order to maintain their efficiency, and this upkeep is certainly equivalent to that of a corresponding number of steel cylinders required for oxygen in the gaseous state. The vacuum containers must be free to ventilate into the atmosphere and, in order to bring them to the same temperature as the liquid and to maintain that temperature, evaporation to waste in a varying degree must be taking place from the time the container is filled at the producing plant until it reaches the user's premises, when the liquid can be completely evaporated into one or more suitable receptacles. This total loss of actual gas would probably be anything from 10 per cent. to 25 per cent., according to the size and condition of the containers and the distance the liquid has to be conveyed.

Against this gas in cylinders can be conveyed any distance and remain unused for any length of time without loss. It therefore appears to me that the saving which is claimed in transporting oxygen in the liquid state owing to reduced space and weight may easily be balanced by the unavoidable losses due to evaporation.

Now, as regards claim (A) in connection with the cheap production of liquid and the distribution of it from one centre instead of several, in order to appreciate the position fully one requires a general working knowledge of the "liquid air" process for abstracting the oxygen from the atmosphere, and I will therefore, in as few words as possible, describe the process. The temperature of the air is first reduced to minus 193 deg. Cent., at which temperature it liquefies, and in that condition its constituents, oxygen and nitrogen, are separated in a rectification column, the nitrogen passing off as a gas at the top of the column and the oxygen collecting as a liquid at the bottom. This oxygen liquid is usually evaporated in the apparatus and the two cold vapours of oxygen and nitrogen are separately conveyed through heat exchangers on their way out of the apparatus and are utilised in this manner to abstract heat from the incoming air, so that by the time the air for treatment reaches the column its temperature has been brought down to nearly the liquefying point, whilst the outgoing oxygen and nitrogen are restored to nearly atmospheric temperatures by the time they leave the apparatus. In this way most of the energy expended in working the plant is recovered and the plant economy depends greatly on the efficiency of this heat exchange.

It will be obvious to those who have read the above description carefully that if the oxygen in the bottom bath of the column is drawn off as a liquid instead of being evaporated in the apparatus and used for cooling the incoming air, its cooling effect is lost and consequently more power has to be expended to counterbalance this loss; in other words, the air will have to be delivered at a higher pressure. Therefore the cost of producing 1000 cubic feet of oxygen in the liquid state is appreciably more than the cost of producing 1000 cubic feet of oxygen in the gaseous state, and this cost roughly corresponds to the cost of power expended in charging the bottles with gas to the trade pressure of 120 atmospheres, so that if for the moment other points are disregarded there is no economy in producing and distributing oxygen in the liquid state from plants of equal size.

The German claim is, however, that they could produce all the requirements from one central plant instead of several, as at present, and thereby show an economy in production. There is no disputing the fact that a plant for producing, say, 1000 cubic metres per hour could produce either gas or liquid somewhat more cheaply than a plant for producing only, say, 100 cubic metres per hour if both plants were worked the same number of hours per week or month, but the centralising of the production and distribution for such a large output at one point would lead to a number of complications, the chief of which, I believe, would be in connection with distribution.

To begin with, I think it can be safely stated that at least 50 per cent. of the present users of oxygen gas are small consumers of less than 5000 cubic feet per month, and it would never pay firms using such small amounts to install the apparatus necessary to receive their supplies in liquid form. Then many of the large consumers, such as ship repairers, require the gas in cylinders for working on board ship, so that they would also require their oxygen in gaseous form. It would, therefore, appear to me that only a possible 25 per cent. or 30 per cent. of the whole of the consumers in this country might conceivably adopt the liquid process, all others would still have to be supplied with cylinders from local producing plants; consequently a large central plant would not take the place of existing local plants, but would have to be additional to them, and it is impossible to see how it could be a paying proposition.

There are, of course, other points in connection with this proposed scheme which would require careful consideration, but the objections I have mentioned seem to be so serious that there would not appear to be any gain over the present system either to the producer or the consumer. C. P. N. RAIKES.

London, December 12th.

RECENT BRITISH LOCOMOTIVES.

SIR,—It is certainly to be regretted that Mr. Picori is not in a position to publish the results of the comparative working of saturated and superheated engines on the Italian State Railways. However, according to his list of the types of locomotives in service on the lines, it would appear that all the compound engines are of the saturated steam order, and if it is the fact that these non-superheated compounds were those tested against the superheated simples, then the results cannot be accepted as conclusive. For the comparison to have been a fairer and more reliable one, the compounds should have been fitted with superheaters like those of the corresponding single-expansion engines. The economy in coal consumption of the latter, Mr. Picori states, was one of the reasons for relinquishing compounding, but there can scarcely be any doubt that if the compounds in question had been superheated, the saving in coal would have been in favour of those engines, and not in favour of the simples. The latter, in my opinion, had an unfair advantage over their competitors, an advantage which, from the economic standpoint, entirely vitiates the value of the comparative trials referred to by your correspondent. Superheating being tantamount *inter alia* to increasing the steaming capacity of the boiler.

The possibility of continental engineers reverting from the compound to the simple type is no proof whatever that a compound locomotive cannot be made so successful that no single-expansion engine, within practical limits, could be designed to equal it, no matter what might be the conditions.

It is perhaps quite in the nature of things that Mr. W. T. Hoecker, who prefers the simple engine, should belittle the advocates of compounding. I do not always or necessarily see eye-to-eye with Mr. C. R. King's views, but so far as the compounding of locomotives is concerned, I am probably an even more ardent advocate of that feature than he is. This is partly due to the fact that I was trained to marine engineering, and when I took up locomotive work in 1867, I viewed the locomotive engine in much the same way as a present day chief mechanical engineer regards the old Rocket. When later on the time came round for me to try compounding in the case of locomotives, I was amazed to find that contemporary engineers reduced the cylinder capacity of their compounds to half that for which the boilers were designed. The idea seemingly was that if half the quantity of steam which the boilers could generate were used, considerable economy in steam and therefore in coal consumption would be effected. It is true that the smaller volume of steam was to be used on a larger total piston area, but this course merely restored the power developed to that—or sometimes less than that—of an otherwise equivalent simple when the compound was working on the level, but reduced the tractive effort by 50 per cent. on up-grade running, with the result that in actual practice the British simple locomotive was able to hold its own against its rival. A better and surer method of putting the compound in a position to improve greatly upon the performance of the simple, would have been to retain the original high-pressure cylinder capacity for which the boiler was designed, and then to have added a large low-pressure cylinder. Had not that eminent engineer, Mr. F. W. Webb, fallen into making the same error in reducing the high-pressure cylinder by half, it is more than likely that compounding would be in general use to-day.

When I had the opportunity to work my will on a locomotive, I put the largest high-pressure cylinders on it that the boiler could steam; these were 20in. in diameter, and were placed outside the frames. For the low-pressure cylinder, fitted between the frames, I adopted a diameter of 32in. Not only did I achieve the success which I expected, but found that I could have accomplished even better results had it been possible to provide the engine with another 32in. cylinder. I purposed replacing the low-pressure cylinder with one of 40in. diameter, but this intention was unfortunately never carried out, as I had to retire from my position as locomotive superintendent, owing to ill-health.

I quite agree with Mr. Hoecker that actual draw-bar pull should alone decide the question as to which is, or is not, the most powerful locomotive. Next comes the question of exerting that pull in the most economical manner. In this connection, does Mr. Hoecker, or any other advocate of the simple type, seriously contend that the whole of the potential energy in the steam is used up in that type, and that there is no waste? It is an obvious and well-known fact that with simple expansion the steam is exhausted with a large measure of work still left in it—work which is turned to practical account when compounding is employed. If Mr. Hoecker had driven locomotives, both compound and simple, up gradients of 1 in 25, as I have done, and seen steam from the latter going up the chimney, at 120 lb. pressure, he would instantly have realised the important difference in the exhausts of the two kinds of engines, representing, in the case of the simple, a 50 per cent. greater intensity of the blast with a proportionately greater waste of power and fuel, for the same draw-bar pull. In order therefore to minimise the losses which are due to single-expansion all that need be done is to employ a third cylinder, of such a size as will enable it fully to utilise the energy remaining in the steam after doing its work in the two high-pressure cylinders, instead of being discharged from these cylinders direct into the chimney. What, may I ask Mr. Hoecker, is there illogical in such a proposition? My contention is that if a large boilered engine with two 21in. outside cylinders be fitted with a 44in. inside low-pressure cylinder, it would be as flexible in working as before being altered, and would, moreover, have a power output equal to that of a simple engine with either two 31in. cylinders or four 22in. cylinders, but would develop its power in a more economical manner than could the simple.

Reverting to the Italian State Railways' decision to abandon compounding, such decision, unless it be based on data obtained with a superheated compound, cannot be regarded as conclusive evidence that locomotive compounding is wrong. When several years ago one of the Midland Railway three-cylinder compound 4–4–0's was equipped with a superheater, it gave an economy, as compared with a sister engine, of approximately 22 per cent. in water and 26 per cent. in coal consumption, figures which show that the working of the engine was considerably improved by the application of superheating, and doubtless the Italian State Railway compounds would also have greatly benefited by the same feature, had it been applied to them. JOHN RIEKIE.

London, S.E. 4, December 8th.

THE COMPARISON OF CUTTING TOOLS.

SIR,—Surely one of the greatest difficulties in the way of anyone attempting a technical advance is that of coining terminology which shall be incapable of misinterpretation.

I have applied the term "figure of merit" to the hot-hardness characteristics of high-speed steel, and I am straightway assumed to believe that any tool possessing a high figure of merit must be a good tool, though it is obvious that the same high figure of merit might be possessed by a milling cutter with good teeth or bad teeth or no teeth.

A motor car manufacturer who adopted a steel for his crank shafts without knowing its physical properties, judging its merits as a crank shaft steel by the yearly record of smashes after its adoption, would be in a similar position to the engineer who buys expensive gangs of milling cutters knowing nothing of their essential physical characteristics and judging their merits by the length of time elapsing before they must be replaced.

The motor car manufacturer requires to know first the resistance of his steel to static stresses (its tensile characteristics), then its power of resisting shocks (its impact characteristics).

I suggest that the buyer of cutting tools should require to know first the resistance of his tools to the high temperatures to which they will be subjected (their hot hardness). He may also require to know their capacity for resisting shocks, which no hot hardness test (or cold hardness test) will tell him.

You have referred to the non-ferrous cutting materials, stellite and others of more recent origin, which are capable, under certain conditions, of cutting efficiency exceeding that of any high-speed steel. These substances owe their efficiency to their hot hardness. They are all hard and capable of retaining their hardness at very high temperatures; in other words, they possess a high "figure of merit." Some of them combine with this high figure of merit certain demerits which cannot be revealed by a hot hardness test, expensiveness and a tendency to brittleness. I suggest that progress in the development of tool materials will be attained, as it has been attained in the development of structural materials, by paying attention to their separate physical characteristics, and that the most important of these is hot hardness. EDWARD G. HERBERT.

Manchester, December 14th.

MERCURY BOILERS.

SIR,—I should like to refer Mr. J. S. Wilson, who inquires in your issue of December 2nd, p. 638, as to Howard's mercury boiler, to Hoblyn's "Manual of the Steam Engine," 1842, p. 231, where he will find some particulars.

Thomas Howard included in his patent of 1833 (No. 6639) for a "vapour engine" a boiler of the flash type in which mercury was used to give improved heat transference. To the outer plate exposed to the fire was bolted, with an interposed frame, an inner plate in which were a number of depressed cups 2in. diameter, which dipped into mercury filling the space between the plates; alcohol or distilled water was sprayed on to the plates and the pressure used was about 10 lb. The trial was made in 1835 on H.M. packet Comet with the engine and boiler on a voyage between Falmouth and Lisbon. Fuel consumption was only one-third of that of the ordinary engine of the day.

Possibly the explosion noted as having occurred in 1838 put a stop to further trials, as there appear to be no further records.

H. W. DICKINSON,
Hon. Sec., Newcomen Society.

December 12th.

IN order to stimulate the cultivation of cotton and sugar, the Peruvian Government has completed arrangements with a syndicate of financiers for the irrigation of about 130,000 acres of land suitable for cotton and sugar growing, but now lying absolutely sterile. Work is to begin at once on plant for the utilisation of the waters of the Rio Huancabamba flowing at 8000ft. above sea level. Reservoirs will receive supplies through a tunnel, 11 kiloms. long, bored beneath the Andean Cordillera. The water thus obtained will also serve to irrigate land in the district of Lembayeque, where some of the largest cane mills in Peru are situated. It is also proposed to erect additional mills and re-equip several of those in operation. This should be a good opportunity for British manufacturers of sugar machinery to secure orders.

Railway Matters.

A POSTER is being displayed by the London and North-Eastern Railway in the mining districts which says: "The London and North-Eastern Railway uses 5,000,000 tons of coal per year, keeping 20,000 British miners constantly employed. We help your industry; travel by rail and help ours."

MANY visitors staying at the Royal Station Hotel, York, have had their rest disturbed at night by the noise set up by trains arriving from the North going over the crossings of the lines to and from Scarborough. The crossings have now been re laid in manganese steel on a concrete bed 17in. thick, and it is reported that trains now enter the station much more quietly.

THE Ministry of Transport railway statistics for the month of September last have recently been issued as a Stationery Office publication, price 3s. 6d. They show that, compared with September, 1925, the number of journeys decreased by 3·9 per cent. and the receipts from passengers by 8·3 per cent. The passenger train mileage rose by 2·8 per cent. On the other hand, the tonnage of goods increased by 6·8 per cent. and the goods receipts by 7·7 per cent. The goods train mileage was 3·9 per cent. greater, and the average train load rose from 127 tons to 129¾ tons.

AN interesting case to the owners of their own wagons was recently decided in the Railway Rates Tribunal. The Ebbw Vale Steel, Iron and Coal Company, Ltd., has been sending coal from a certain pit to Ebbw Vale, but there was no occasion to return the empty wagons, as after having been emptied they were reloaded and sent elsewhere. The carriage charge included the cost of returning the empty wagon to the pit, and the colliery company sought, therefore, a rebate, but as the railway company was ready and willing to return the wagons the request was refused.

WE referred in this column on December 2nd to the proposal to abandon a section of the Oystermouth Railway. In that article which appeared in THE ENGINEER of August 1st, 1924, of our series "One Hundred Years of British Railways," it was related that the Oystermouth Railway was sanctioned in 1804 and opened in 1814. A peculiar feature of the empowering Act was that the haulage authorised was "by men, horses, or otherwise." No powers were given to carry passengers, but in an article on "Railways" in Brewster's "Edinburgh Encyclopædia" (1824) it was said that "at Oystermouth a stage coach plies daily with passengers, which appears to be its chief trade." In 1877 horse traction gave way to steam, and in 1893 the name of the company was changed to the Swansea and Mumbles Railway.

DURING a fog on the morning of the 7th instant, an excursion train from Gainsborough to London ran into a standing London, Midland and Scottish passenger train from Leicester at Peterborough North Station on the London and North-Eastern Railway. A passenger in the standing train was so seriously hurt that he died on Friday from his injuries. A verdict of accidental death was returned at the coroner's inquest on Monday. This unfortunate mishap makes the third passenger train accident this year in which passengers have lost their lives. The total number of passengers killed in train accidents this year is twenty-six, which figure is the highest recorded in this connection since 1915. Not since the collision of March 28th, 1915, at Smithy Bridge has a passenger lost his life in a collision owing to fog.

THE *Manchester Guardian* usually is well informed on locomotive matters, and therefore it is instructive to hear on its authority that considerable success has attended the tests which have been carried out by the London, Midland and Scottish Railway with the Caprotti valve gear. An engine fitted with the gear has been subjected to the test of the dynamometer car, and from that test satisfactory results have been obtained. In fact, so satisfactory has been the service of this engine up to date that the London, Midland and Scottish Railway is considering the fitting of further engines as an extension of the test. In comparing the results with those obtained with an engine not fitted with the Caprotti valve gear, but working under similar conditions, it was revealed that higher average speed was maintained with less coal consumption.

ON the motion of Lord Montagu of Beaulieu, the question of railway companies and road transport was discussed in the House of Lords on the 6th instant. Viscount Peel, who spoke on behalf of the Government, said that it did not take the same gloomy view as the noble lord. If there was to be considerable diversion of heavy traffic from the railways to the roads, it would follow that the reduction of the railway traffic would have the effect of increasing the overhead charges of the railways, and heavier freights would have to be charged. He could not at the present moment define what the action of the Government would be. All the proposed safeguards or restrictions which Lord Montagu had mentioned, and many others, would be considered and the Government would form its opinion when it knew precisely what the Bills of the railway companies would be.

IN reporting on the fatal accident to a driver at Sutton, on the Southern Railway, who climbed on to the coal bunker of his engine to assist his fireman and whose head came into contact with the electrical overhead traction wire, Mr. Main, the Senior Assistant Inspecting Officer of the Ministry of Transport, stated that a porter volunteered the information that he had saved many a man by warning him when about to climb up on to the bunker of an engine in a similar manner at that particular place. Mr. Main made three recommendations. One was that the staff generally be instructed to report such occurrences which come within their observation; a second was that a prominent warning notice should be permanently displayed within the cab of each engine working over overhead electrified sections of the line. The third recommendation was that as engines of steam-worked trains normally come to a stand at or near the point where the accident took place and where the overhead live wire is only 13ft. 11¼in. from rail level, the section of live wire be made "dead" at that point, as is done at other places on the system where similar conditions apply.

Notes and Memoranda.

BUILDINGS are growing to such a height in the United States that the most recent ones, such as the Mather Building in Chicago, which rises to a height of 553½ft., have to be anchored down into the ground to resist the over-turning effort of wind pressures.

THE majestic proportions of the timber trees of Western America is generally agreed upon, but may not be fully appreciated. Those proportions may be gauged by the fact that a heavy logging railway is carried across a river in Clatsop County, Oregon, on two Douglas fir logs in a single span. The logs are approximately 100ft. long and are about 5ft. in diameter.

ON the new line which has been constructed to connect Sydney with Broken Hill one of the difficulties that will have to be contended with is, according to the *Industrial Australian*, the drifting of sand on to the land, due to heavy winds in dry periods. The N.S.W. Minister of Lands (Mr. Ball) believes that a special form of sand plough will have to be used to clear away this obstruction.

ABOUT 6000 tons of casein are used annually in Finland, chiefly in the ply-wood industry. This casein has been imported from France and Argentina *via* Germany and Great Britain. Although casein has been made in Finland on a small scale, steps are now being taken to develop the manufacture and improve the quality. As Finland is a large milk-producing country the prospects of development seem favourable.

IN a paper read before the South African Institution of Engineers Mr. E. S. Laschinger suggested that one means of improving the atmospheric conditions in the working places of deep mines would be the local compression, cooling and re-expansion of a portion of the ventilating air. In re-expansion the air would help to drive the compressor, and in the process the air would be dehumidified. For an expenditure of about 81 horse-power a supply of 1000 cubic feet of cold dry air could be provided per minute.

THE potential energy of a stream in flood is well exemplified in an article in the *Engineering News-Record*, concerning the recent floods in New England. The actual duration of the floodings is not recorded, but the Black River, for instance, left its banks above a power station dam and carried away 1,500,000 cubic yards of material which was spread out on adjacent low-lying land. Otter Creek also broke its banks, and invading a railway cutting fell over a declivity of about 100ft., carrying away some 500,000 cubic yards of soil.

INVESTIGATIONS carried out in connection with the manufacture of power alcohol in Australia show that it could be made for eighteen pence a gallon. In this connection it is suggested that the difficulty of starting internal-combustion engines using such fuel may be obviated by the addition of some such volatile fuel as ether, or else by flooding the cylinder and then closing the throttle so as to prevent the entrance of much free air. By flooding and closing the throttle an engine using only a 30 lb. compression can be started with ease even if the cylinders are coated with ice. In order to neutralise any acids that may develop in the combustion of alcohol a small quantity of ammonia may be added. When this is done there will be no corrosive effect.

THE New York 132-kV cable between Hell Gate and Dunwoodie power stations in the New York area was put into commission last August. The cable composing this tie line, states *World Power*, is of the single-conductor pattern, filled with oil under pressure derived from elevated reservoirs at terminals and intermediate points. The line has a carrying capacity of 90,000 kW, and is 12 miles long. The cables were tested with a continuous pressure of 300 kV for 15 min. before being switched into service, a kenetron apparatus being used for the pressure test. The placing into service of the cable marks a new departure in super-tension cable practice, and results, if favourable, will confirm the theory that the reliability of cables for high pressures depends largely upon the avoidance of air spaces in the dielectric.

ECONOMISER explosions are unusual, so the following extracts from a recent official report may be of interest. The economiser which failed in a Lancashire mill was properly equipped with dampers and a by-pass flue, but it exploded through overheating when the check valves were all closed, and the furnace gases were passed through it, instead of through the by-pass. The Engineer Surveyor-in-Chief points out that:—"Part of the regular routine with plants such as that dealt with in this report should be to shut the dampers on the economiser flue prior to shutting off the feed-water supply to the economiser and to see that the feed-water is circulating *vid* the economiser before reopening the same dampers. Apparently this was not done in this case, a serious explosion being the result. The likelihood of such occurrences would be greatly reduced if the dampers were more clearly marked to indicate their position and notices explaining the proper and safe method of handling were placed at the damper levers and feed valves."

INQUIRIES that have been addressed by various wood-using industries to the Forest Products Research Laboratory of the Department of Scientific and Industrial Research concerning timber seasoning and conditioning point to the need of a *résumé* of the present knowledge of the subject and an explanation of the various factors involved in the process. A report just issued seeks to meet this need, and is written primarily for the use of the trade. The first half of the report contains a description of wood structure and its bearing on seasoning, illustrated by diagrams and photographs, a discussion of the moisture relation of wood and atmosphere with reference to the correct moisture content that timber should possess under different conditions of use, and an explanation of the method of determining the moisture content of wood. The remainder deals with the difficulties encountered during seasoning, the causes of defects which arise during the process, and the methods of piling best calculated to overcome or lessen defects, with photographs illustrating these methods. A short appendix is devoted to the important subject of decay caused by fungi during the transport, seasoning and storage of timber.

Miscellanea.

A TIMBER company is being organised in Mukden, Manchuria, to work the forests in the Tung Pien Circuit. The company is capitalised at £100,000.

THE plant of the Sub Nigel gold mine, Transvaal, which now has a capacity of 19,500 tons of ore per month, is to be extended so as to be capable of handling 27,000 tons monthly.

AFTER much consideration it is now reported that the Government of Bengal has decided to abandon the Grand Trunk canal project, which has met with decided opposition from all parties.

THE last of the seven sections of the 50,000-ton floating dock for the Singapore naval base was launched from the Wallsend shipyard of Swan, Hunter and Wigham Richardson on the 10th inst.

IT is reported from New York that a process for the production of glycerine from molasses has been evolved by the du Pont Company, and that the cost of production is about 5 per cent. of present costs.

AN extensive coal area has been discovered at Yingopu, along the Mukden-Hailung Railway, in the Fengtien province of China. The provincial government has decided to work the deposit jointly with the merchants.

ARRANGEMENTS are being made to demolish the great smoke stack at the works of J. Townsend, Ltd., chemical manufacturers, Crawford-street, Port Dundas, Glasgow. The stack, which was erected in 1857, had an original height of 488ft., and was the highest erection of its kind in the world.

HOPES are entertained that a considerable number of openings may be found in Canada for miners who have failed to find employment in this country since the coal stoppage. As the result of recent geophysical surveys, rich lodes of minerals of various kinds have been discovered in the Dominion, and their exploitation is as much dependent on a supply of experienced miners as upon the capital which, unhappily from some points of view, appears to be forthcoming from American sources.

THE Government of the Province of Quebec, Canada, has taken steps which will ensure the construction of the Lake St. John Railway in that section of the province in which British capitalists have practically decided to spend large sums of money in the development of natural resources. At the last session of the provincial legislature a Bill was passed providing for the sum of 567,000 dollars toward the construction of the line, but actual payment of the subsidies was withheld until recently.

As a part of the development of the Western Copper Mine on Khutze Inlet, in British Columbia, a contract has been awarded to the Vancouver Engineering Works for the manufacture and installation of an aerial tramway, of the double-rope type, having two track cables and an endless traction rope, to which the carriers will be attached by detachable grips. The tramway will have a capacity of 500 tons a day, and the length will be 3000ft. on an average gradient of 51 per cent., the cable being supported on steel towers. The approximate weight of the material required is 80,000 lb.

ORIGINALLY built in 1872, the Southern Railway high-level bridge over the river Medway at Maidstone has been reconstructed. The heavy "King Arthur" and "Lord Nelson" engines now haul the continental boat expresses over the Maidstone East route as an alternative to the Tonbridge line. The preliminary work had been going on for some months past, and during this time the bridge had to be temporarily supported on a heavy timber staging erected on piles over the river. The original brick piers have now been extended, and the two old bow-shaped girders replaced by two new lattice steel girders.

A FEW days ago the laboratory and test room of the Government Radio Research Station at Ditton Park, Datchet, together with valuable wireless apparatus, were destroyed by fire. Members of the staff were at their luncheon when the fire broke out. Fire brigades were quickly on the scene, but the building, which for the most part was composed of wood, burnt quickly, and it was found impossible to save any of the valuable apparatus within it. An aerial lattice mast 200ft. high, situated in the centre of the building, caught fire and presented an extraordinary appearance as the flames ran up it. Presently it crashed to the ground, smashing the surrounding fencing as it fell.

AFTER doing service for over a hundred years, the iron suspension bridge which connects Buckinghamshire and Berkshire at Marlow has been declared inadequate to support present-day traffic, and it has been decided to demolish it and build a new ferro-concrete bridge faced with stone instead. The existing bridge has a beautiful setting with Marlow Weir and Quarry Woods as a background when facing downstream. It is stated that the new bridge will be a single-span bridge, and it is estimated that the scheme for the demolition of the old bridge and the construction of the new bridge will cost £70,000, and will take two years to build. During that period a temporary bridge will be thrown across the river a little above the present bridge, to take light traffic. To meet the cost of the bridge the Ministry of Transport will make a grant of £45,500, and the County Councils of Buckinghamshire and Berkshire will each contribute £12,250.

THE proposals with regard to motor parking in London, contained in the report of the London and Home Counties Traffic Advisory Committee, while not receiving unqualified approval from the officials of the Automobile Association, are regarded as a useful contribution towards the solution of a very difficult problem. They express satisfaction particularly with the recommendations that the officially recognised car parks should include Charterhouse-square, Finsbury-circus, Finsbury-square, West Smithfield, and Trinity-square. Hitherto there have not been any authorised parks in the City. The recommendation that the places where vehicles may park and the conditions which must be complied with should be more clearly indicated also meets with general approval. Sign-posts and distinct lettering, it is pointed out, will prevent the parking of cars beyond the limits prescribed, and render motorists less open to the risks of prosecution for such offences.

SHANNON POWER SCHEME—CONSTRUCTIONAL WORK AT POWER-HOUSE SITE AND WEIR

THE SIEMENS-SCHUCKERT COMPANY, BERLIN, ENGINEERS

(*For description see page 674*)

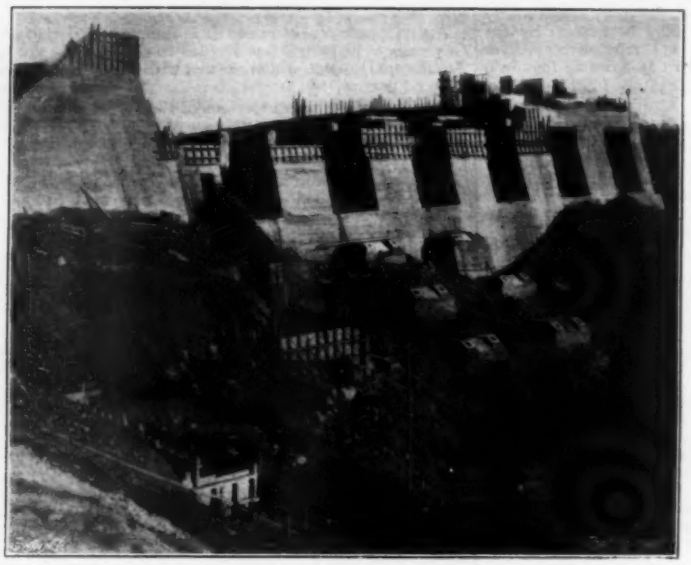


FIG. 35—INTAKE SLUICES, FROM POWER-HOUSE

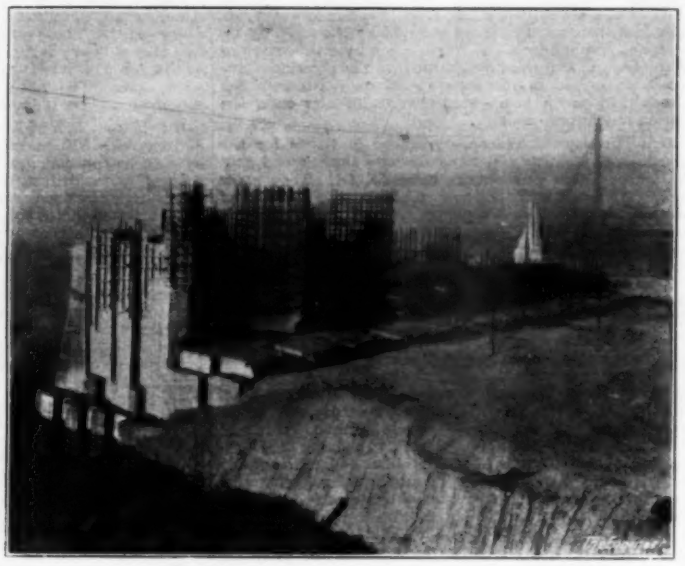


FIG. 36 INTAKE SLUICE-HOUSE, FROM HEAD-RACE

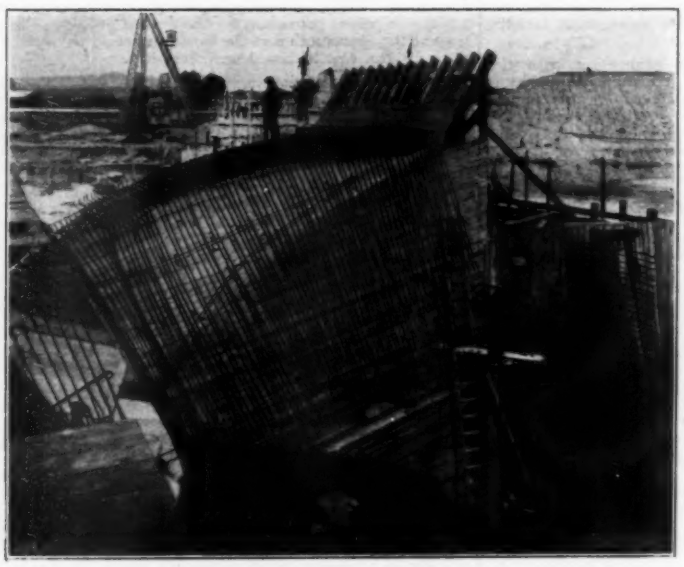


FIG. 37—REINFORCEMENT AT HEAD OF PENSTOCK

FIG. 38—INTAKE BUILDING UNDER CONSTRUCTION AT THE WEIR

FIG. 39—CONCRETE AND EXCAVATION WORK AT WEIR AND INTAKE

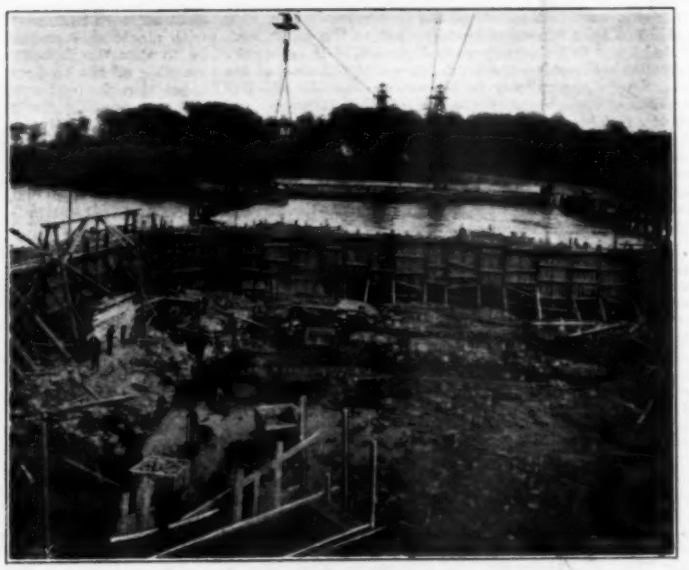


FIG. 40—ROCK EXCAVATION INSIDE COFFERDAM AT WEIR

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THE ENGINEER.

DECEMBER 16, 1927.

The Federation of Engineering Societies.

A NATURAL, perhaps an inevitable, consequence of the development of engineering and its penetration of industries with which at one time it had little or no connection, is the creation of specialised societies for the benefit of those who have devoted themselves to one branch. Within the memory of many men still living the parent societies, which could be numbered upon the fingers of one hand, satisfied all the requirements, and even at this day the three great societies—the Institution of Civil Engineers, the Institution of Mechanical Engineers, and the Institution of Electrical Engineers—are far ahead of any other single society in membership and influence. But never a year goes by without the formation of some new body established to deal with some single industry or science associated with engineering. Including branches, of which many hold meetings for the reading and discussion of "branch" papers, there are in Great Britain approximately one hundred societies which occupy themselves with engineering matters or subjects closely allied to them. Whilst relatively few of these societies aim at as high a standard of membership as that very wisely insisted upon by the greater institutions, and whilst many of them accept a type of paper that would not be acceptable to the parent societies, there is, inevitably, a great deal of overlapping and, no doubt, a certain measure of wasted energy. At the same time it cannot be denied that every society which conducts its work earnestly, and with a due sense of its responsibilities, performs a useful function by encouraging the diffusion of knowledge and experience. Where they fail is that, by attachment to their own interests, instead of to that of the whole body of engineers, they give rise to a disunity of action and effort.

For many years the advantages that would accrue from the unification of engineering societies have been recognised. On several occasions attempts have been made to bring the great institutions into closer alliance. Amongst such attempts may be recalled those of Sir Robert Hadfield and Sir Alfred Yarrow, who, being impressed with the merits of the American Engineering Building, in which a large number of societies are housed, endeavoured to effect a similar fusion in London. With the reasons which eventually overthrew that scheme we need not now deal. The time when anything of the kind was possible has passed, and as far as can be seen, the opportunity for its revival is remote. We are concerned rather with the segregation which is taking place within the great societies themselves by the creation of separate specialised bodies. Of the four or five great institutions, none suffers more from this action than the Institution of Mechanical Engineers. If, for the moment, we may discount the claim of the Institution of Civil Engineers that it covers all engineering which is not military, then no question remains that the scope of the Institution of Mechanical Engineers is larger than that of any other body. In this diversity of interests lies its strength and its weakness. Owing to it, it may justly claim that its influence extends over a wider field than that covered by any other society, but, also owing to that diversity, it is open to more segregation than other, more centralised, bodies. There are probably more minor associations connected with subjects which fall within the province of that Institution than of any other. It is not surprising, therefore, that, as the speeches of recent Presidents and Members of Councils have shown, it is giving very earnest consideration to the problem of devising some means which may have the effect of bringing societies doing kindred work into closer harmony with it. The problem is a difficult one. It is not likely to be solved in a day. Rather must we hope that by the encouragement of the spirit of co-operation and by easy stages the movement will grow until something akin to a general federation of all kindred societies is established. Hence, the suggestion advanced by Mr. J. H. Barker, chairman of the Yorkshire branch of the Institution of Mechanical Engineers, in the address which he delivered in Leeds on December 8th, is of great interest. Mr. Barker's proposal is that a beginning should be made by conjoint publication of the "Proceedings" of several societies. The "Proceedings" would be arranged according to their subjects and any member of the Federation—or whatever name it may be given—would be entitled to receive gratis the volumes relating to two subjects; the other volumes he could buy at cost price. The editing would be entrusted to a committee drawn from a few of the larger societies. Such a beginning, according to Mr. Barker, would result in the gradual uniting of societies, their buildings, libraries, lectures and educational facilities which would be open to all. The steps to attain union must be slow, but the uniting of accumulated knowledge, said Mr. Barker, surely offered a line of least resistance.

If it be once agreed, and we cannot see how agreement can be lacking, that some form of unification-with-autonomy of the numerous societies would be beneficial to the profession of engineering, then any scheme which advances us even if it be but by a little towards that great object must command careful consideration. The plan propounded by Mr. Barker is sound in itself, and offers a means of approach to which little serious objection can be taken, even by the most individualistic society. It could not, as far as we can see, fail from any defect of principle, and if it is possible to form a suitable organisation to operate it, it should form a very useful and effective step towards a close and effective fusion of societies. But everything turns in the first place upon the existence of a general desire for federation. Once that is attained, and we believe it is not very remote, the practical details of Mr. Barker's scheme, or of any other equally or more hopeful scheme which may be put forward, will be arranged, not without much difficulty, but in the end triumphantly.

Locomotives in South Africa.

MORE than ordinary interest was aroused in this country when it became known about two years ago that orders for two engines of what are now called the "15 C." and "16 D." classes, had been placed with the Baldwin Company of Philadelphia, without competition, and that, conditional upon these engines proving satisfactory, further orders were to be placed for ten more engines of the "15 C." and five more of the "16 D." types. There is nothing exceptional in a transaction of this kind, and, as a special correspondent, who has just returned from South Africa, shows on another page, American makers were in a better position to tackle the propositions of the South African Railways than were British makers. A problem which had to be solved was how to

reduce the time between Cape Town and Johannesburg without lessening the load. This the Baldwin Company guaranteed to do, and for the purpose put forward an engine of its own design at what appeared a reasonable price. Two of these engines were to be made and tried, and if they were satisfactory an agreed further number of the same type was to be ordered. The trial was satisfactory and the transaction was completed. The result is that the 966 miles' journey between Cape Town and Johannesburg is now done in 29½ hours, and that one engine does the whole trip. It has been asked why a British firm was not offered a contract on similar lines, but on reflection it will be seen that that would have been unreasonable. The real question is, Why did not a British firm convince the management of the South African Railways that it could solve the problem, and so secure the first order without competition? No sooner was the success of these experiments assured than the main points in the Baldwin engines were embodied in the specification of the South African Railways, and tenders called for more engines of the "15 C." and "16 D." types. These the Baldwin Company did not secure, for the simple reason that, on its own design, it was beaten in price by the American Locomotive Company. British firms tendered, but in every case their prices were too high. The next few weeks should show what success home firms have attained in the tendering now under consideration.

It is not sufficiently realised that nowadays all matters relating to locomotives and rolling stock are discussed and settled in Johannesburg. Tenders are called for there, and without local representation it is not possible to obtain an order. And, as it is not always possible to refer to makers in England any technical questions that may arise, representatives should be qualified to discuss them on the spot. Technical representation is essential. The representative of a firm should not only be able to educate the user in the matter of the products of his firm, but he should be able to discuss with him the technical points involved. There is no reason why British firms should not make engines of the "15 C." and "15 D." types or wagons of 100 tons capacity. The fact that these types of engines and wagons are not used in England is no argument, for British firms have for many years supplied the South African Railways with wagons of far greater capacity than are used at home, and locomotive builders are constantly at work on engines of types unknown in the British Isles. It is on price that British makers fail, and with the best local representation possible, great as its importance is, the initial handicap of a price too high is not easily overcome.

Empire Development and the Engineer.

By DOUGLAS SPENCER.

ALTHOUGH the duties of an engineer come under the category of "professional," yet there is room in that profession for various types of engineer. We might indeed divide engineers into three classes:—

(1) The engineer who knows how to make machinery or to construct engineering works.

(2) The engineer who can sell the products of the first.

(3) The development engineer who has a particular gift for wide and general observation, and who can see how his profession can assist in providing means for the utilisation of the resources of Nature.

The qualities which are essential in each of these classes are briefly:—

(1) Exact technical knowledge.

(2) Sound engineering knowledge with critical aptitude and a knowledge of psychology.

(3) A general knowledge of what engineers can do, what their fellow scientists in other branches can do, and what opportunities exist for the utilisation of that knowledge.

If one analyses the staff of any engineering business, one finds that the individuals can be grouped in these three classes. Most fall under one class only, some under two, and only rarely can an engineer qualify for all three classes. Study of the duties of one class are sufficient for most men who call themselves engineers.

But it is particularly with the engineer of the third class and his qualifications that the writer wishes to deal in the present short article, and of the part which he plays, and could play, to a greater extent, were the uses of such an engineer more clearly recognised, and the value of his assistance in the matter of Empire development more strongly brought home to those whose duty—though their first duty is to govern—is also to develop the resources of the territories which are under their direction. Let us have by all means well-ordered possessions first, but let us all see to it that their prosperity is commensurate with the responsibility which falls upon our Government and ourselves in having coloured so large an area on the map "red"—a rather unfortunate colour.

The British method of territorial development—that is to say, development by means of detached units and separate interests acting independently of each other—has possibly the advantage of having got certain things done which had they waited for even ancillary developments might not have to-day been completed achievements. On the other hand, the Germans' method of looking at a country as being something capable of development by a programme and "according to plan" was economical and speedy, however far "out" they may have been in their psychological calculations in regard to the inhabitants.

At present we develop our Empire in the same manner as we have in the past repaired our London streets—piecemeal. The latter is now altered. We have accepted the principle of town planning, for the sake both of appearance and convenience no less than economy. Our Empire Marketing Board is organising the interchange of Imperial products, mainly things that grow. The Board is also, however, extending its duties into the mineral field, in its co-operation with Australia in testing new methods for the survey of minerals and oil. In this connection the success attained in electrically prospecting for minerals will no doubt lead not only to quicker location, but also to the discovery of unexpected deposits. In 1923 very important deposits of copper were located at Bjurfors and Boliden in the district of Vesterbotten in Sweden by the electrical method, and the system has been proved in many parts of the world at the present time with great success. It is not too much to hope that the laborious work of geological survey parties will be greatly speeded up by the adoption of electrical prospecting methods and that the added knowledge of the unexplored parts of the earth within reach of its surface, coupled with the knowledge which we already possess both of its mineral and agricultural possibilities, will lead to a much higher speed of development than has ruled heretofore.

There is undoubted room, and especially at the present time, for what we may call the study of "development engineering" and the creation of a type of engineer who can co-ordinate development, working in conjunction with scientists and others who will co-ordinate investigation. It is work which is not done at present by any engineer from the point of view of deliberate co-ordination, although co-ordination may happen.

In some of the Indian States there exist industrial engineers whose duties embrace the study of increase of agricultural production, compilation of records of mineral resources, the development of power supplies, whether steam or water, the study of such questions as electro-chemical and electro-metallurgical possibilities, transport possibilities, steam and electrical, the establishment of industrial works dealing with cotton, wool, oil, tobacco, timber, &c. He is the one man to whom all go should they feel that their own particular development would be made easier if a more general development of the district were proceeded with, which is undoubtedly often the case.

All engineers, however, know that the work of a "development engineer," if an ordinary engineer is rash enough to act in that *rôle*, brings in but little grist to his own mill, and the industrial engineer of the type paid for by Indian States is, so far as we know, non-existent in any other Dominions, Colonies, or Protectorates except Canada.

Cheap power and cheap freights are two important essentials in the development of Empire resources, and they can best be attained by well co-ordinated development by a "development engineer" who could be a really legitimate charge on the general revenues of any growing country, and one of whose duties, after acquiring an intimate knowledge of the resources of the country to which he had been allotted, would be to investigate the knowledge which the older world has acquired in the development of its own resources and the building up of its industries, and apply that knowledge in the development on systematic and co-ordinated lines of his own particular territory.

The old system of giving large concessions of territory to syndicates or companies for them to develop as they will cannot be called an actual failure, but it has been far from producing the speedy development which, to relieve the hardships of to-day and to ensure efficient employment of professional men, all of us must strive after and assist to bring about.

THE Federation of British Industries collected information a year ago as to the speed of transit and delivery by railway companies, and reported that "there was a continuous deterioration in the speed of deliveries from 1921 onwards," and that "it was depressing to find that the grouping of the railways into four large amalgamations had not yet apparently had the result of improving their efficiency." Since last summer another inquiry has been held, which has given rather more reassuring results.

Literature.

History of the Great Western Railway. By E. T. MACDERMOT, M.A. Great Western Railway Company, Paddington Station, London. 1927. Price 21s.

IN order to produce a worthy history of an undertaking like a great railway, it is necessary to find a competent writer, and to give him access to the records. These conditions have been complied with, resulting in two volumes, called Parts I. and II. of Volume I. of the history of the Great Western Railway as far as the year 1863. The rest, it is understood, is to appear some time in 1928.

Even before the Stockton and Darlington Railway had been finished, a proposal for a railway to be worked by locomotives between London and Bristol was made, the survey being carried out by McAdam. This project, however, came to nothing, and the matter was dropped until after the completion of the Liverpool and Manchester Railway. In 1832 a fresh scheme was put forward by William Brunton, who, twenty years before, had produced the walking locomotive, and a man named Price, but they carried it no further. A serious start was made at the beginning of 1833, and Brunel, who was appointed engineer, made a fresh survey. The Bill received the Royal Assent on August 31st, 1835.

The question of gauge was discussed in a report by Brunel of September, 1835, in which he estimated the maximum resistance caused by gradients on the main line as 2 lb. per ton—corresponding to 1 in 1120—and the "constant resistance, which we will call friction," at 8 lb., from which he inferred that "the latter will constitute 80 per cent. of the whole resistance"; thus overlooking that of the air. He intended the width of the carriage bodies to be the same as on the narrow gauge, thereby proposing to throw away one of the advantages of the broad.

The North Star hauled the first train to Maidenhead on May 31st, 1838. This engine was the mainstay of the company, and it is lamentable that the directors had the ingratitude and vandalism to break her up, together with the Lord of the Isles, in 1906. She was also the type from which were evolved the magnificent machines that ran the broad-gauge expresses for nearly half a century. Though she stood out among the rest of the stock, which consisted of a bunch of absurd daddy-longlegs with tiny boilers, minute cylinders and huge wheels, she must have been a little crude when delivered, if we are to believe the story that in 1839 they knocked two-thirds off the fuel consumption by opening up the blast pipe and centring it with the chimney.

On June 30th, 1841, the line was opened between London and Bristol, and on May 1st, 1844, the Bristol and Exeter Railway was completed, and a train worked through from London, 194 miles; Gooch driving the Actæon there and back.

Everyone knows that immense sums of money were expended by the early railways in obtaining their Acts, but few realise how much continued to be poured out by the established companies over each proposal for a new line. Between two and three hundred pages of the work under review are mainly taken up with quarrels and manœuvres, which included every imaginable move, from providing employees with shares for voting purposes, down to forging seals. One feels with Mr. MacDermot that even the former of these tricks is rather discreditable, but apparently it depends on the point of view, as in a history of the London and North-Western Railway, published in 1914, we find this very proceeding, in one of the most flagrant cases—brought to naught by a Parliamentary Commission—called "as pretty a move as is to be found in the history of British railways!"

The chief opponent with whom the Great Western had to contend in all matters concerning territory to the north of its main line was Captain Huish, the redoubtable secretary of the North-Western. A past-master of railway intrigue, he was originally on the Grand Junction Railway, and when, in 1845, the amalgamation with the London and Birmingham was being arranged, in order to bring the latter into a suitable frame of mind, he actually proposed to connect with the G.W.R. and "mix" the gauge of the Grand Junction!

It was impossible to move to the right or the left without a fierce struggle. A four years' war with the L. and S.W.R., 1844 to 1848, was said by Locke to have cost between three and four hundred thousand pounds; and even then none of the lines finally authorised was ever made, owing to the severe financial depression that came on.

When the depression was growing worse, deputations from the boards of the G.W.R., L. and N.W.R., and L. and S.W.R. met to discuss a permanent amalgamation of all three, but were unable to come to terms. Of course, Parliament would never have listened to such an arrangement at that time. A series of lesser amalgamations came about, chiefly as a result of the financial straits of the smaller companies, and at the end of 1863 the total mileage was about 1100.

Mr. MacDermot has an interesting chapter dealing with signals. Some of us can remember the old disc and crossbar signals, characteristic of the G.W.R.,

which had to be perforated in order to reduce the pressure of the wind on them. The electric telegraph was first brought into use for signalling trains on December 1st, 1847, in the Box Tunnel, which was rather a terror to the timid.

The next subject is Train Service. At first mishaps of every possible kind were always occurring. The low speeds and light weight of the stock made derailments comparatively unimportant from the passengers' point of view, except perhaps for a little extra shaking, and more than the usual delays. In 1843 the average speed, exclusive of stops, was 33 miles an hour. In 1845 the expresses were put up to 43, including stops. In 1847 they were actually timed at 55 min. for the 52¾ miles between Paddington and Didcot—over 57 miles an hour. In 1852 they relaxed their efforts, being allowed 68 min. for the run to Didcot. Ten years later the old timing was restored, but only for a time.

The final portion of the work deals with the engines, and was written by the late Mr. Ahrons, who was the best possible man for the task.

The most extraordinary of the early "freaks" were Harrison's two engines, with boilers on a separate carriage, and it is a pity that not either of them is illustrated, since Colburn gives a diagram of the Thunderer, which is probably fairly correct. There seems to be no reliable drawing extant of the Hurricane, which had 10ft. wheels. The other had 6ft. wheels geared up, in a proportion said to have been 27 to 10, which would have made them the equivalent of over 16ft. Other accounts are given as 2 to 1 and 3 to 1, but it is possible that none of these figures are correct. The frontispiece to the third edition of Wood consists of an engraving of the machinery, and shows the gear wheels with 74 and 22 teeth, which would make the ratio 37 to 11, and the equivalent wheel 2in. over 20ft. One tooth less on the large wheel would have brought it under the 20ft., which may very likely have been what they were aiming at.

On page 776 we are given an illustration of the Lord of the Isles with the original tender, and on page 264 one of the Sultan, with the sandwich frame tender. These are said to show the original state of the engines. They do so very nearly, but not quite, as there are small "wind screens," like ears, on the fire-box, and sand-boxes, both of which features must have been later additions. Celebrated as these engines were, good drawings of them are very scarce, most of the early writers only giving small illustrations. The best consist of five large plates of the Iron Duke, in an undated edition of Tredgold, published about 1850. No weatherboards or sand-boxes appear. Nor do they in small drawings in a book by Sewell (1852) and in Clark (1855). They are also absent in Frith's picture of 1862, "The Railway Station," and in a photograph of the Sultan which was given to him by the company to assist him when painting it.

The last chapter deals with Carriage and Wagon Stock, and is on the same high level of interest as the rest. There is, however, no description of a very peculiar type of luggage van, which appears in some of the plates of Bourne's "Great Western Railway," and also in the one of Bath Station reproduced on page 140. It had sides sloping at about 45 deg., which were hinged at the top and opened upwards.

The practice of carrying luggage on the roofs of the carriages, which had been given up at an early stage, was reintroduced in 1859, and not finally abandoned until the early 'seventies.

In conclusion, we have to add that this ambitious and arduous work has been splendidly carried out. The type is good, and the only regrettable feature is that the pages are not large enough to do justice to the illustrations, many of which lose much of their effect by having been so drastically reduced.

BOOKS RECEIVED.

Mathematisches Praktikum. Part I. By Dr. Horst von Sanden. Leipzig: B. G. Teubner. Price 6·80 marks.

The Disposal of the Sewage of the Sanitary District of Chicago. Illinois: State Water Division, Urbana, U.S.A.

Britain's Fuel Problems. London: *The Fuel Economist*, 530, Abbey House, Victoria-street, S.W. 1. Price £2 2s. net.

The "Mechanical World" Year Book. 1928. London: Emmott and Co., Ltd., 20, Bedford-street, W.C. 2. Price 1s. 6d. net.

The Great Physicists. By Ivor B. Hart. London: Methuen and Co., Ltd., 36, Essex-street, W.C. 2. Price 3s. 6d. net.

Steel Works Buildings. By A. G. Swift. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 3s. 6d. net.

Electric Control Gear and Industrial Electrification. By W. Wilson, M.Sc., M.I.E.E., &c. London: The Oxford University Press, Falcon-square, E.C. 1. Price 25s. net.

The "Practical Engineer" Mechanical Pocket Book and Diary, 1928. Edited by E. G. Beck. London: Oxford University Press, Falcon-square, E.C. 1. Price 2s. 6d. net.

Jane's Fighting Ships, 1927. Edited by Oscar Parkes, and F. E. McMurtie. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price £2 2s. net.

The Practical Engineer Electrical Pocket Book and Diary, 1928. Edited by Conrad Arnold. London: The Oxford University Press, Falcon-square, E.C. 1. Price 2s. 6d. net.

The Making and Rolling of Iron.*

By JOHN W. HALL.

THOROLD ROGERS in "The Industrial and Commercial History of England" says:—"During the fourteenth century iron in mass was worth in money of the time £9 a ton. Now twelve is a very reasonable multiplier on the whole of the fourteenth century prices." This would make its price equivalent to £108 per ton to-day in our money. He also says:—"In the sixteenth century iron was half the price at which it was purchased in the fourteenth," and further adds, "In the latter part of the seventeenth century . . . . wrought iron was more than twice as dear as rolled lead, £36 6s. 8d. per ton; while lead was only £16 7s., and the multiplier at this time being two, in modern money £72 13s. 4d. and £32 14s." In "Six Centuries of Work and Wages" he says:—"The most formidable item of expenditure on the supply of necessary dead stock (*i.e.*, the fourteenth century farm) was the annual cost of iron."

E. C. Eckel, in "Coal, Iron and War," says:—"We may fairly summarise the matter by saying that in our last period of very low prices" (*i.e.*, in 1897), "iron sold at one-quarter of the price it commanded in the depression of 1740; and at less than 1 per cent. of its fourteenth century price."

In the Middle Ages the output of iron was very trifling In 1591 a forge could not make more than 2 tons of bars a week, and owing to shortage of water to turn the wheel often made only 50 tons a year. So long as the price of iron was so high there was no inducement to use it for purposes for which some other material would serve, which was cheaper and more easily worked. Water tanks and pipes were more conveniently made of pewter or lead, and brewers boilers and stills of copper. Savery's engines seem to have failed because the lead pipes burst; Newcomen's engines had brass cylinders and pumps, lead pipes and probably copper boilers. Boulton and Watt preferred copper for boilers; Watt's first engine had a cylinder made of hammered iron, probably tinned sheet, with soldered joints; he writes proposing to make cylinders 24in. diameter, only one-fortieth of an inch thick, and laments that "My old white-iron man is dead." Both Brindley and Watt tried cylinders of wooden staves hooped like a cask; most colliery mechanics still talk of their "pump trees" and the housewife of her "copper."

Let us consider how wrought iron was made, and how its cost was reduced, until a mill of a size suitable for rolling iron became commercially practicable, when at last it was possible to construct it, and to drive it by steam at a sufficient speed.

Passing over those days when wrought iron was produced directly from the ore in quantities of 7 lb. at a time, "manufactured iron," even 250 years ago was made in a "finery" or Lancashire hearth, not much bigger than a large smith's fire, in quantities of 50 lb. to 100 lb. at a time by exposing heated pig iron to a blast of air. This method is still employed to make steel in Styria, and for the "Lancash-Swedish" steel produced in Sweden. The grade of iron made varied widely, so that the insufficiently decarbonised pig often crumbled under the hammer, and had to be returned to the finery for further treatment. It was then heated in a "chafery" and repeatedly hammered to expel the rather infusible slag. The "stamp" was next broken into short pieces, which, being irregular in composition, were drawn out, doubled and welded together under the hammer, the bar being called common, best, best best, or treble best, according to how many times this operation was carried out—terms still in use though the practice has long been discontinued. About 32 cwt. of pig and 24 cwt. of charcoal were used in making a ton of bar, and according to Scrivenor, "It was considered a respectable establishment that could turn out in one week 20 tons of bars fit for the market."

The greatest difficulty was to obtain charcoal at any price; the supply was so restricted that between 1720 and 1750 the make of bar in the whole of the kingdom was only 250 tons to 350 tons per week, and was then falling, although the use of coke in the blast-furnace had become fairly common by the end of that period. It was a further fifty years before really satisfactory bars could be produced from pig smelted with coke, though coke had been used to some extent for the chaferies, and even charcoal pig was occasionally converted in the fineries by coke instead of charcoal. The terms "charcoal finish" and "coke finish" are still used to describe the quality of tin plates, though neither charcoal nor coke are any longer used in their production.

In 1784 Henry Cort introduced his process of "dry" puddling on a sand bottom in a reverberatory furnace, in quantities of 200 lb. at a time, and showed for the first time how bars could be produced entirely with pit coal. He used grooved rolls to reduce the spongy ball to a puddled bar, which he cut up, piled, hammered and re-rolled to suitable sections in other grooved rolls.

Cort's furnace produced 8 tons to 10 tons of iron per week, against 3 tons to 4 tons made in a hollow fire. He could turn out of his mill in twelve hours 5 tons of small or 15 tons of large bars, against a ton of average sizes produced under a hammer. Rees' Cyclopædia, published in 1819, says the rolled iron was not always as good as the hammered, and we know from other sources that Cort piled his puddled bar and worked it under a hammer, before he re-rolled it to size.

The fact is puddling on a sand bottom was somewhat uncertain, and the process was much improved five years later by Homfray of Penydarren, who removed the excess silicon in a refinery or running-out fire, and laid the foundations of the fortunes of Welsh ironmasters. In 1787 Richard Crawshay, at Cyfarthfa, was producing only 10 tons of bars per week from a hollow-fire heated by coke, and those of very poor quality; in 1803, after adopting Cort's process, he made 60 tons to 70 tons per week of good bars, and by 1812 his output had risen to 200 tons a week.

The loss of iron in puddling, said to have been over 20 per cent., was much reduced when Rogers of Nantyglo, in 1816–1818, replaced the sand bottom by one of iron, lined with oxidised scrap iron fused in place; he claimed to have increased the output per furnace per week from 8 tons to 20 tons and sometimes to 24 tons.

The last and greatest advance was made when Joseph Hall, of Tipton, in 1839, lined his puddling furnace with a partially fusible oxide of iron, and "boiled instead of baked his pig," in 4 cwt. to 5 cwt. lots, at a high temperature, in a bath of fluid basic oxide. In all previous processes the fluid oxide necessary for removing the carbon from the pig had been obtained by oxidising the iron itself, but by supplying it from outside, Hall removed this source of loss. It also rendered unnecessary the preliminary refining, which caused a loss of 15 per cent. of iron, and consumed 7 cwt. to 8 cwt. of coke per ton of iron refined; and an old workman told the writer that it was less laborious to work 5 cwt. by Hall's process than 2 cwt. on a sand bottom, by Cort's, and, of course, the waste in puddling was much less.

Moreover, while Cort's process only removed the silicon and carbon, Hall's also sensibly reduced the phosphorus and sulphur, making a much superior material. It was essentially the same process for removing phosphorus as the basic open-hearth steel process b ought out fifty years later, save that the much higher temperature obtainable in the Siemens furnace fuses the iron as well as the slag, so that the light fluid slag can float on the surface of the bath of molten ingot iron. In Hall's furnace the grains of decarbonised pig never got beyond the plastic stage, and the viscous slag could not be entirely squeezed or beaten out from between the particles of iron.

Hall's process completely established the reputation of South Staffordshire bar. Captain Brown, afterwards Sir Samuel Brown, an original and far-seeing man, realising how much easier it was to handle an iron chain than a cumbrous hemp anchor cable (which, moreover, was easily destroyed by chafing on sharp rocks) got chain cables adopted by the Royal Navy, although they cost 6d. per pound. To determine their strength about 1813 he made a testing machine which measured the breaking strength of the iron, and of the cable made from it; this was twenty years before the Admiralty put down their cable-testing machine at Woolwich Dockyard. Brown demonstrated so clearly the superiority of Hall's South Staffordshire iron that the larger part of the ships' cables made in the world are still produced within a radius of a few miles round Dudley Castle, and the chain cable trade provides to-day the chief demand for South Staffordshire bars.

Old processes die hard. The writer remembers seeing refineries at work in South Staffordshire, and sheet clippings bushelled up in a hollow fire by charcoal to make charcoal tin-plates. Refining before puddling has always been the rule when making best Yorkshire iron, and there is evidence that iron was made direct in the bloomery in that county as late as 1780.

In the remainder of the paper Mr. J. W. Hall dealt with the origin and development of methods for rolling metals, illustrating his remarks with a large number of lantern slides.

* Newcomen Society. December 7th, 1927. Excerpt.

SIXTY YEARS AGO.

IN our issue of December 13th, 1867, we returned to the question of steel *versus* iron rails. We had, we said, had some very hard things said about us for having urged engineers to exercise caution in substituting steel for iron in the construction of permanent way. Our warning voice had not sounded pleasantly in the ears of the "steel-at-any-price party." Our argument was based on the belief that Bessemer steel could not be produced in quantity with a guaranteed uniformity of properties, and that it appeared to suffer in time a molecular deterioration under the impact of passing trains. There had been a conspicuous failure of a Bessemer rail at Chalk Farm, and using that failure as a text we had in a previous issue advanced the view that steel rails perfectly sound to all appearances might, in the course of a few years, become brittle and unsafe. Within a fortnight of the appearance of our first article on the subject, our views had, we held, been justified by another conspicuous failure of a steel rail, this time on the line across Charing Cross Bridge. Good fortune and the fact that the rail had been laid on longitudinal instead of transverse sleepers alone, it would seem, had prevented a serious disaster. The faulty rail weighed 70 lb. per yard, and after its failure a portion of it was tested. It failed under the blow of a 300 lb. monkey falling through 13ft., the length of the section tested being 4ft. We admitted that the trial had been severe, and that it had shown the rail to possess no small power of endurance. The fact that it had failed in service and yet withstood a high test showed, we said, that the rail was not uniform from end to end, and reinforced our argument regarding the uncertainty of Bessemer steel. We seemed to be strongly in favour of the iron rail, not in its then modern form, but as made in days gone by. It was not true, we said, to argue that good iron rails speedily wore out. We instanced iron rails laid in 1844 on a portion of the Dover and Folkestone line, carrying heavy traffic, which had lasted for twenty years. On the main line to Redhill there were iron rails still in service which had been laid twenty-three years previously, and which were still in good condition. The question, we argued, was not to be settled by comparing the performance of Bessemer rails costing £12 or £14 a ton, with that of iron rails costing £5 10s. The best iron rails could not be obtained for the second-named figure. So far as Bessemer steel for general use was concerned, the time was, unknown to us, rapidly approaching when Siemens-Martin steel would replace it for many purposes. In the second of our leading articles in the issue we have named we dealt at some length with the work done on the manufacture of steel by Messrs. Emile and Pierre Martin with the aid of a Siemens regenerative furnace. We described the method of manufacture as undoubtedly promising, but were apparently less concerned with its significance to the engineer than with the fact that there appeared to be nothing in it which was really patentable.

IT is proposed to establish an aeroplane factory at Tsingtao, China. The cost is estimated at about £40,000.

GEAR-BOX NOISE-TESTING MACHINE

THE HIGHFIELD ELECTRICAL COMPANY, LTD., COVENTRY, ENGINEERS

(For description see opposite page)

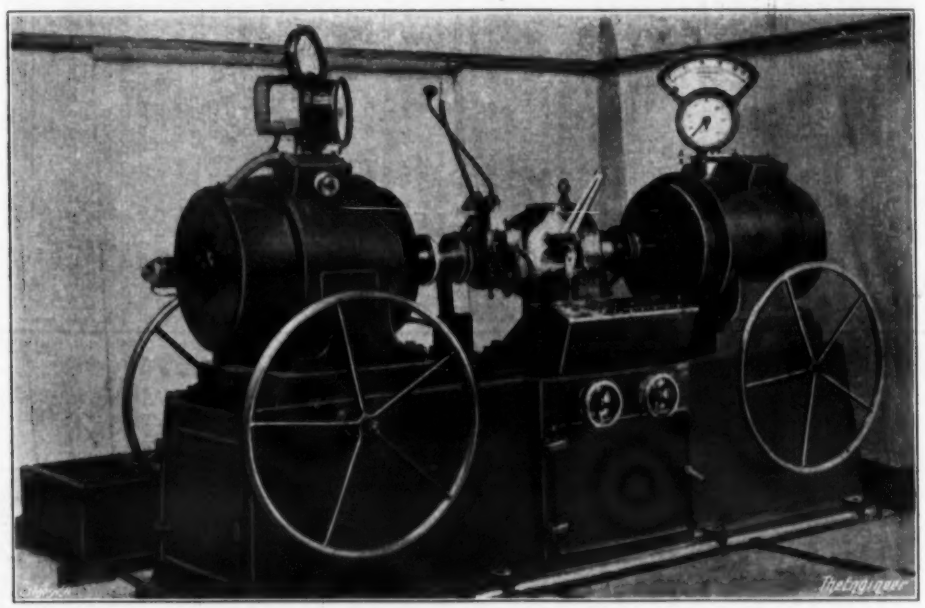


FIG. 1—GEAR-BOX UNDER TEST

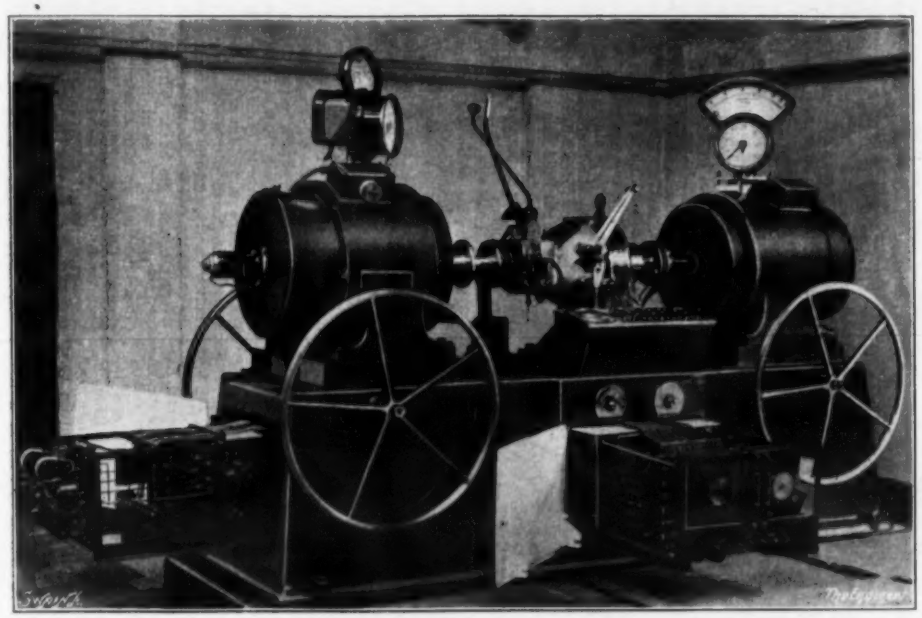


FIG. 2—ELECTRICAL CONTROL GEAR

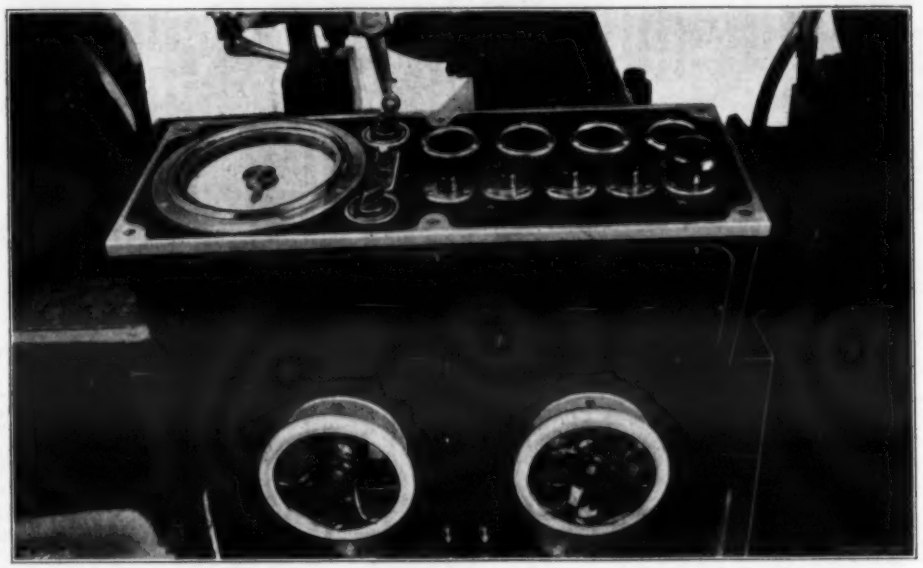


FIG. 3—CONTROL DESK

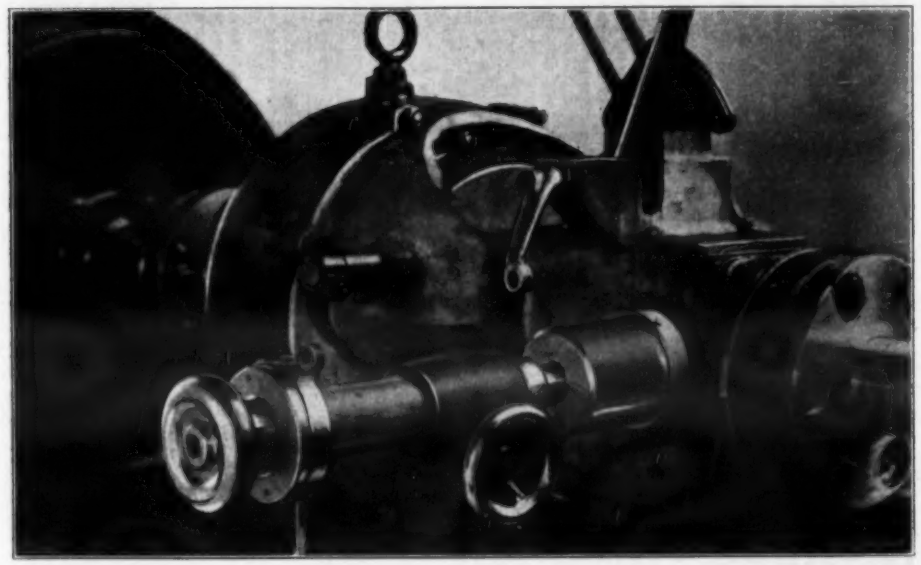


FIG. 4—MAGNETIC PICK-UP DEVICE

A Gear-box Noise-testing Machine.

UP to the present moment there has been no standard apparatus on the market by means of which a maker of gears, gear-boxes and back axles for motor cars or other machinery could test his product before it was finally built into place. For this reason, even if there were no other, the apparatus illustrated herewith and on page 690, should be of considerable interest, as by its use all kinds of gear units can be tested as a simple production operation. The apparatus tests the units under exact speed and load conditions, and, further, it indicates the magnitude of the sound emitted by the unit in such a manner that the sound can be definitely certified as conforming or not to a predetermined standard. These results, it is claimed, can be achieved by any intelligent user, and are in no wise dependent on personal judgment.

The efficiency of a gear-box or back axle, to instance two very common forms of gear unit, may not be of particular interest to the producer of-to-day, for with modern methods of production it is found that efficiency is fairly constant, and does not vary very much with different types. It is, however, a remarkable fact that no two gear-boxes or back axles made by the same machinery by the same methods, and to the same limits of accuracy, give off the same amount of noise when run under load. At present, when there is so much keen competition in the motor industry, this matter of noisy units is of supreme importance, and it is becoming more than ever necessary that the units should be run under standard conditions and tested for noisiness before they are built into a chassis.

To accomplish this result, the majority of manufacturers have been forced to build a special fixture, in which the unit is driven by an electric motor and the load applied by means of a friction brake operated by a hand lever. The gear-box or back axle, as the case may be, is placed on the fixture and the load applied by the operator, who listens most carefully to the noise given off by the unit. These arrangements are in general use, but are held to be unsatisfactory, owing to the fact that the loading conditions are seldom duplicated in any two tests. In addition, the personal opinion of the operator is the means by which the final result is determined, and in this respect it is found that what one operator will decide to be a noisy unit is thought by another operator to be reasonably quiet. Furthermore, it has been proved that an operator will condemn a unit one day for being noisy and may pass it on the next day as being quiet.

There is undoubtedly a general demand in the motor industry particularly, for a machine with which gear units can be tested by semi-skilled or normally skilled operators, and by means of which duplicate load and speed conditions can be successively applied. The apparatus is also required to give a visual indication of the noise emitted by the unit and a measure of its efficiency. An apparatus to achieve these objects has recently been placed on the market by Heenan and Froude, Ltd., Worcester, and takes the form of the machine, a front view of which is given in Fig. 1, page 690. The machine has been developed by Mr. F. W. Highfield, managing director of the Highfield Electrical Company, Ltd., Coventry, for whose electrical testing equipment Heenan and Froude, Ltd., act as sole selling agents.

The apparatus illustrated is intended for testing motor car gear-boxes and is built around a fixture upon which the gear-box unit is mounted. The machine as a whole is varied slightly, according to requirements. That shown in our engravings is intended for laboratory work. It can, however, be arranged for workshop use, but the essential features are the same in both cases.

The fixture is formed to suit the gear-box to be handled, and in the instance illustrated consists of a housing to which the gear-box, complete with the clutch mechanism, is bolted, exactly as it is when mounted on the fly-wheel casing of the engine. The housing contains a dummy fly-wheel, which is mounted on a spindle running in a substantial bearing. The fixture is mounted at the centre of a heavy box section bed, which incorporates two slideways running parallel and central with the axis of the fixture. Mounted on the slideways are two separate rack-and-pinion operated slides, and on these slides are fixed two special motors. One of these motors is for driving the gear-box and the other for applying the load. The driving motor is arranged for direct-current supply and is totally enclosed. The armature shaft is fitted with a flexible coupling, containing a female spline which engages with the splined shaft of the gear-box when the motor slide is racked forward by one of the large hand wheels in front of the machine bed. At the driven or cardan shaft end of the gear-box, the usual universal joint is engaged with a splined shaft of the loading device in the same manner as the driving member. The whole arrangement is such that the gear-box can be connected or disconnected to the apparatus in a few moments. The loading member is arranged for direct-current supply, and is really a totally enclosed generator. Like the driving motor, it is built to be as quiet as possible in operation.

In the production machine, as distinct from the laboratory type, there are two fixtures which are mounted on a turntable, either fixture being brought into the working position by revolving the table through 180 deg. and registering it by means of a lever-operated plunger. With this machine one operator tests the gear-boxes while another attends to the loading. The gear-boxes are brought to the machine by a conveyor, and after being mounted on the fixture they are filled with clean oil from a tank in the machine base. After testing, the oil is drained from the gear-box into a second tank, from whence it is filtered and returned to the supply tank.

The apparatus is controlled from a desk—shown in Fig. 3—which contains a stop push button, a light load start button, and one button for each speed of the gear-box. These buttons are arranged at the front of the desk, the stop button being to the right and the light load start button to the left. The three remaining buttons are employed for applying the load on each speed of the gear-box, the first speed button also being used for the reverse gear. There is also provided to the rear of the desk a series of coloured lights disposed immediately behind the various push buttons. These lights show at a glance which button has been depressed and indicate exactly what operation is in progress.

In the production machine the operation of the push buttons is as follows:—The pressure of the left-hand

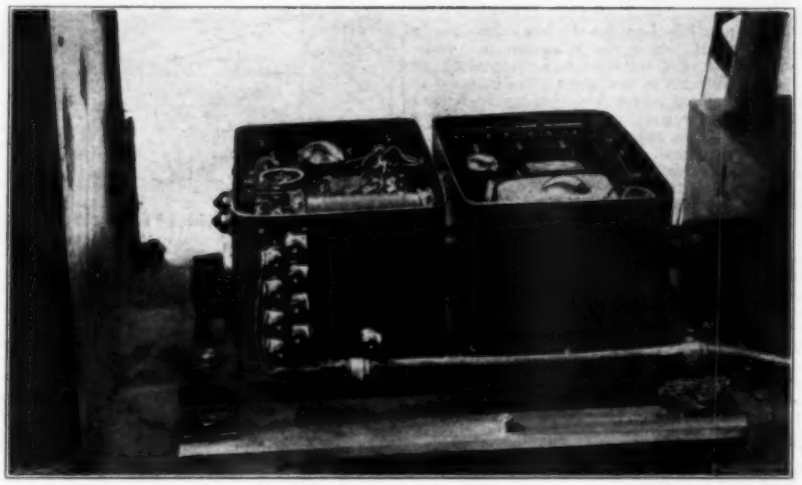


FIG. 5—VALVE AMPLIFIER

button switches on current to the driving motor, which is gradually accelerated from standstill to the normal speed, and also completes the circuit of the generator through a resistance properly proportioned to the load which has to be transmitted through the gear-box at that particular speed. In addition, one of the three other buttons is depressed, according to the speed-controlling device. This action accelerates the motor gradually up to a maximum speed of 3000 revolutions during a period of 30 secs., causes it to dwell at this speed for 10 sec., and then decelerates it down to a standstill during a further period of 30 sec. After this cycle of operations, the entire machine comes to a standstill. The same cycle of operations occurs when the second, third and successive buttons are depressed, with the difference that loading conditions on the loading generator are altered to suit the difference in torque and speed corresponding to the various speeds of the gear-box. The machine can be stopped at any moment by means of the stop button.

In the laboratory type machine the operations of varying the speed and load are performed by hand, as it may be desired in this particular type to maintain a given speed and load for an indefinite period for observation purposes. The laboratory machine also has a speed indicator calibrated from 300 up to 3500 revolutions per minute, together with a horse-power meter, calibrated to the full horse-power to be transmitted through the gear-box. The meter is mounted on the motor on a special pedestal, so arranged that it is not affected by vibration. A similar speed indicator and horse-power meter are mounted on the loading generator, the only difference between the two sets being that the second is arranged to indicate the speed and power in both directions, in order that readings may be given when the gear-box is run through the reverse speed.

On the production machine no instruments are provided for measuring either speed or power. The range of these factors is automatically fixed, and it is not intended to take any record of efficiency. In both machines provision is made for measuring the sound given off by the gear-box, the noise indications being registered on a meter, mounted on the control desk to the left.

The indicating meter has a circular scale divided into one hundred parts. It measures the noise by means of apparatus consisting of the following essential parts. There is mounted on the machine bed at the rear—as shown in Fig. 4—a heavy cast iron bracket, which is insulated from the bed by means of a thick rubber mat, with rubber insulating bushes to take the holding-down bolts. The bracket carries a short arm, through the upper end of which is mounted a brass barrel that slides transversely, and can be fixed in any endwise position by means of a clamp operated by a small hand wheel. The arm itself can be swivelled on its base bracket, so that the barrel can be set in front of the gear-box as shown in the engraving. At one end of the barrel there is a chamber, within which is a magnetic pick-up device terminating in a steel contact needle. The needle protrudes through a steel bush mounted in the face of the cap at the forward end of the barrel, while the magnetic pick-up is mounted on a steel shaft passing through the barrel. The arrangement is such that the needle can be made to protrude through the steel bush or be withdrawn by means of a hand wheel at the rear end of the barrel. In operation it is essential that the steel needle should be brought into gentle contact with the side of the gear-box. The latter acts as a resonator and will vibrate the needle, thereby causing the magnetic pick-up to generate an electric current, which varies in proportion to the amplitude of the vibration of the wall of the gear-box.

The minute current generated by the pick-up is passed to a special form of valve amplifier, which is housed on a sliding platform in the machine bed—as shown in Fig. 5. By means of the amplifier the current is magnified to a sufficient extent to be passed to the indicating instrument on the control desk. A reading is thus obtained on the indicator, which is stated to be directly proportional to the sound given off by the gear-box.

It is essential that the needle of the magnetic pick-up should be correctly adjusted in contact with the gear-box, and the apparatus is arranged so that the adjustment can be effected both easily and quickly and without damage to the delicate parts of the apparatus. In actual practice the barrel can be slammed hard against the side of the gear-box and clamped in that position. The adjusting handle is then given a half-turn and the apparatus is in correct adjustment. Before the adjusting handle is turned, the needle of the magnetic pick-up is sheathed by the barrel, but when the handle is turned the steel bush at the forward end moves backward and the needle forward, thus exposing the needle and adjusting it to the face of the gear-box. In this position and with the correct current passing through the amplifying equipment, a true and perfect indication is claimed to be given of the amplitude of the sound waves given off by the gear-box, but no perceptible difference whatsoever is made by change in the frequency of the noise.

It is important that the high and low-tension current supplied to the valves of the amplifying equipment should be constant to enable definite comparisons to be made of the readings of the indicating meter. The amplifier is, therefore, supplied with current through a special type of battery eliminator. This eliminator is connected to the electrical supply mains, and passes to the valves of the amplifier the correct current and voltage under all conditions. The equipment is housed at the right-hand end of the machine bed, the electrical control gear being housed in front and at the left-hand end—see Fig. 2. In all cases the equipment is carried on panels that slide easily on a runway and can be readily withdrawn for the purpose of inspection without disturbing any of the electrical connections.

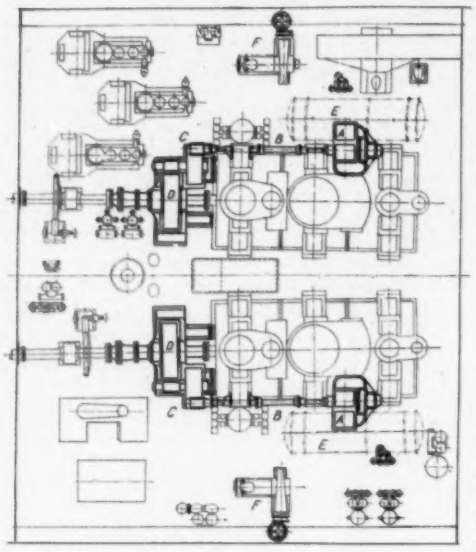
As there is no known standard of noise, it is obvious that the equipment we have described can only be utilised for comparison purposes. The accepted method by which it is used is to test a gear-box of known characteristics, which is regarded as satisfactory in use, and to record the indications shown by such gear-box on the apparatus. This record is then regarded as a standard to which all similar boxes are required to conform. Limits can be set which may be within so many degrees of the indications given off by the standard box, below which all gear-boxes would be acceptable. Any gear-box giving a reading in excess of the limit would be rejected as being too noisy. It will thus be seen that it is possible to assign a figure of merit to every gear-box tested, thereby cutting out the personal element and establishing a standard of reference to which all production may be referred.

It may be mentioned that the checking and calibration of the apparatus has led to a surprising amount of information regarding the adaptability of the human ear to the appreciation of sound. It is found that although the ear is usually acutely sensitive to changes of pitch, it is seldom sensitive to small changes in amplitude, and that on the average it requires a falling-off of practically 25 per cent. in the amplitude of a noise before the average listener can be certain that a change has taken place. These facts made it necessary for very careful investigation to be made of acoustic properties before the apparatus could be offered for production work. In this connection, it is only necessary to mention one method which was adopted as a test of the sound-indicating apparatus. A gear-box was tested with the magnification of the amplifier adjusted to a known and definite figure. With a certain speed and load on the gear-box the indications were carefully recorded on the meter. Gramophone records were then made of the noise given off under the same conditions of speed and load, and the finished records were played over to the sound-measuring apparatus through the magnetic pick-up. The result obtained by these means was a reading consistent with that taken direct through the gear-box.

The switchgear arrangements of the speed and loading device in their essential details consist of four automatic switches for closing the required circuits in sequence. There is also an automatic accelerating contactor for starting and stopping the driving motor, a motor-driven speed regulator for the automatic acceleration and deceleration of the machine, and a bank of resistances which are cut out as required by means of the contactor switches. In addition, there is an overload relay for the isolation of the electrical gear from connection to the main supply in the event of an electrical or mechanical fault causing an abnormal overload. In the production machine the pressing of the five push buttons on the control desk results in (1) the machine being started; (2) one-third generator resistance being connected; (3) two-thirds generator resistance connected; (4) full generator resistance connected; (5) stop. In the laboratory model there are two hand wheels below the desk. One of these wheels operates the shunt field regulator which is in circuit with the motor, the result of the operation being to raise or lower the speed of the driving unit. The other hand wheel is for the purpose of operating a shunt regulator in the field or loading generator, the result in this case being to increase or decrease the torque absorbed by the loading generator. With the machine in use it is understood that the results obtained are such as to have cut down gear-box rejections on tested cars from something like 12 to 3 per cent.

Recent Developments of the Marine Exhaust Steam Turbine.

IN a paper which was read at Glasgow before the Institution of Engineers and Shipbuilders in Scotland on Tuesday, December 6th, Dr. Gustav Bauer, of Hamburg, dealt with some recent developments in the use of exhaust steam aboard ship. In introducing his subject, Dr. Bauer made reference to the combined installations of high-



A Exhaust Turbine.
B Connecting Shaft.
C First Reduction Gear and Hydraulic Clutch.
D Main Wheel with Second Reduction Gear.
E Condenser.
F Circulating Pump.

FIG. 1—ENGINE AND TURBINE ARRANGEMENT

pressure reciprocating engines and low-pressure turbines, which have been successfully employed on the triple-screw liner Olympic, and other vessels of the White Star Line. The original idea, he went on to say, of combining a reciprocating engine and a steam turbine on the same shaft had first been conceived by Sir Charles Parsons. That plan had not, however, been followed up until very recently. Now increased experience in the manufacture of gearing and elastic couplings, and the study of vibration phenomena in rotary systems, had led to the designing of combined reciprocating and exhaust turbine systems, such as were described in the paper.

After discussing the theoretical steam and thermodynamic cycles of the reciprocating engine and the exhaust steam turbine, and demonstrating the economies to be obtained by using that combination of prime movers, the author proceeded to analyse by means of a Mollier diagram the working conditions for a steam engine with an exhaust turbine added to it. The example taken by Dr. Bauer was of interest as it referred to the actual machinery installation on the newly reconditioned twin-screw cargo and passenger steamers Cap Norte and Antonio Delfino, belonging to the Hamburg-South American Line. The vessels have a deadweight carrying capacity of 9080 tons, and the general arrangement of their propelling machinery is shown in Fig. 1.

Referring to Fig. 1, it will be seen that the exhaust steam turbines with the gearing are shown by thick lines, the reciprocating engines with the auxiliaries being represented by the thin lines.

As tests were made on the Cap Norte both before and after fitting the exhaust turbines, and also on the Antonio Delfino after fitting the turbines, the exact steam conditions and the power developed were accurately known. The diagrams reproduced in Fig. 2 are mean indicator diagrams for both sets of machinery, in which the dotted lines apply to the conditions before the exhaust turbines were added and the continuous lines to those after. In the paper, with the aid of a heat-entropy diagram, Dr. Bauer follows the heat drop through the successive expansions from the steam entering the high-pressure cylinder until the condenser is reached. Before the conversion was made it is shown that there was a total output as represented by the areas of the three diagrams of 2605 I.H.P., with a steam consumption of 11·08 lb. per I.H.P. hour. With the low-pressure turbine added and indicator cards, as shown by the continuous line in Fig. 2, cut-offs being the same, there was a total I.H.P. of 3590, which figure includes a computed I.H.P. for the turbine of 892, corresponding to a S.H.P. of 800 measured by the torsionmeter. The addition of the exhaust turbines produced a saving in steam consumption of 22 per cent. and a saving of fuel of 25 per cent. With the exhaust turbines added, the speed of the ship was increased from 14 to 15 knots.

The dimensions of the reciprocating engines and the steam conditions are as follows :—

Diameter of the H.P. cylinder	680 mm. (26·8in.)
Diameter of the I.P. cylinder	1100 mm. (43·3in.)
Diameter of the L.P. cylinder	1800 mm. (70·9in.)
Stroke	1300 mm. (51·2in.)
Revolutions per minute	80
Steam pressure in boiler	15 atmos. (213 lb. per square inch absolute)
Temperature in boiler	300° C. (572° F.)
Superheat	103° C. (185° F.)

Another interesting point is the effect on the torque developed of adding an exhaust turbine. In all the installations which have been so far converted, it has not been necessary, we understand, to put in a new propeller shaft, as the addition of the exhaust turbine, although increasing the output has, at the same time, reduced the variation in mean torque.

The curves shown in Fig. 4 are for the two ships already referred to, and clearly show the reduction in torque variation from a mean of 60 per cent. to a mean of 25 per cent. That this reduction is not due to the increase in speed given by the added power is shown by the second torsionmeter diagram, which was taken at the same machinery output and the same revolutions as before the exhaust turbine was added.

Dr. Bauer outlines in his paper the steps to be taken on calculating new exhaust turbine installations. He recommends that large exhaust bends should be adopted in which the steam velocity would not be more than, say, 131ft. to 197ft. per second. A series of curves are also given showing the increase in power and decrease in steam consumption which is made possible by the addition of an exhaust turbine under certain assumptions as regards back pressure in the low-pressure cylinder, vacua, and the condition of the boiler steam whether saturated or superheated. In this section of the paper the author has included a chart of isotherms, showing the mean cooling water temperature for a given steamer route during the whole year. Some of these mean temperatures given may be quoted :—London–New York, 56·7 deg. Fah.; London–Buenos Aires, 68·7 deg.; London–Sydney, *vid* Suez, 69·5 deg.; London–Sydney, *vid* Cape Town, 62·6 deg.; London–Jamaica, 72·7 deg.; Liverpool–Montreal, 40·4 deg.; Vancouver–Yokohama, 56·9 deg.; Vancouver–Sydney, 73·6 deg. Fah.

The remainder of the paper is mainly devoted to the consideration of various types of exhaust turbine plant of the Bauer-Wach system. We take as an example that quoted for an exhaust turbine installation at present under manufacture in one of the yards of the Deutsche Schiff und Maschinenbau Aktiengesellschaft, for a 9500 tons deadweight freight ship.

The cylinder diameters of the triple-expansion engines of this ship are respectively 800 mm. by 1330 mm. by 2140 mm. (31·5in. by 52·4in. by 84·3in.), the stroke 1520 mm. (60in.), the boiler pressure 16 atmospheres (228 lb. per square inch absolute), the steam temperature at the superheated outlet is 350 deg. Cent. (662 deg. Fah.), and the revolutions 72 per minute. The present output is 4400 I.H.P.; after the addition of the exhaust turbine it will be about 5400 I.H.P.

Fig. 5 shows the existing reciprocating engine with the new exhaust turbine installation. From the low-pressure cylinder A, the steam flows through the exhaust steam oil separator B, and the change-over valve C to the exhaust turbine D. The output of the turbine is transmitted by the intermediate shaft E to the gear-box F, which is connected to the propeller shaft G. During manœuvring the turbine is cut out by means which will be explained later, and the steam from the low-pressure cylinder flows directly to the condenser through the change-over valve C, when during manœuvring and going astern the existing reciprocating engine only is working.

The details of the exhaust turbine plant are shown in Fig. 3. Here the turbine D, which is of the Parsons reaction type and runs at 3065 r.p.m., is shown in section. As will be seen it drives the pinion H by the comparatively low transmission shaft E, which is so stiff and well supported that whirling is eliminated. The pinion H

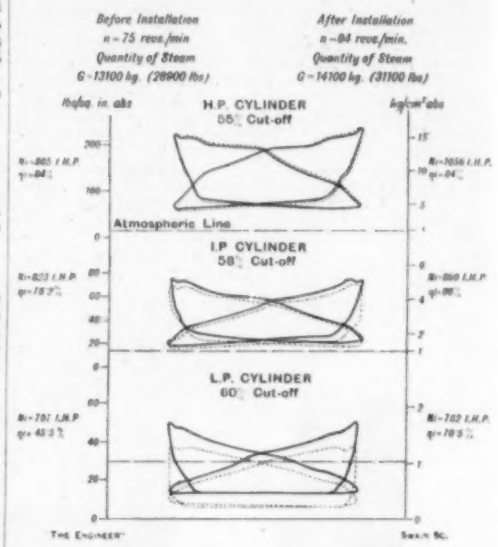


FIG. 2—MEAN INDICATOR DIAGRAMS

meshes with the gear wheel J of the first reduction gearing The pinion K of the second reduction gearing which meshes with the main gear wheel L, is connected to the intermediate gear wheel J by the hydraulic Vulcan coupling O_1O_2. The main gear wheel L is keyed to the shaft R, which again is connected by the intermediate coupling piece T to the propeller shaft G.

The Vulcan coupling is constructed according to the principle first used by Professor Föttinger. It consists of the two halves O_1 and O_2 containing a number of simple radial and axial blades dividing each into a number of cells, which are filled with lubricating oil. The transmission efficiency of the coupling is from 97 to 98 per cent.; that is to say, the difference in revolutions between the driving part O_1 and the driven part O_2 is from 2 to 3 per

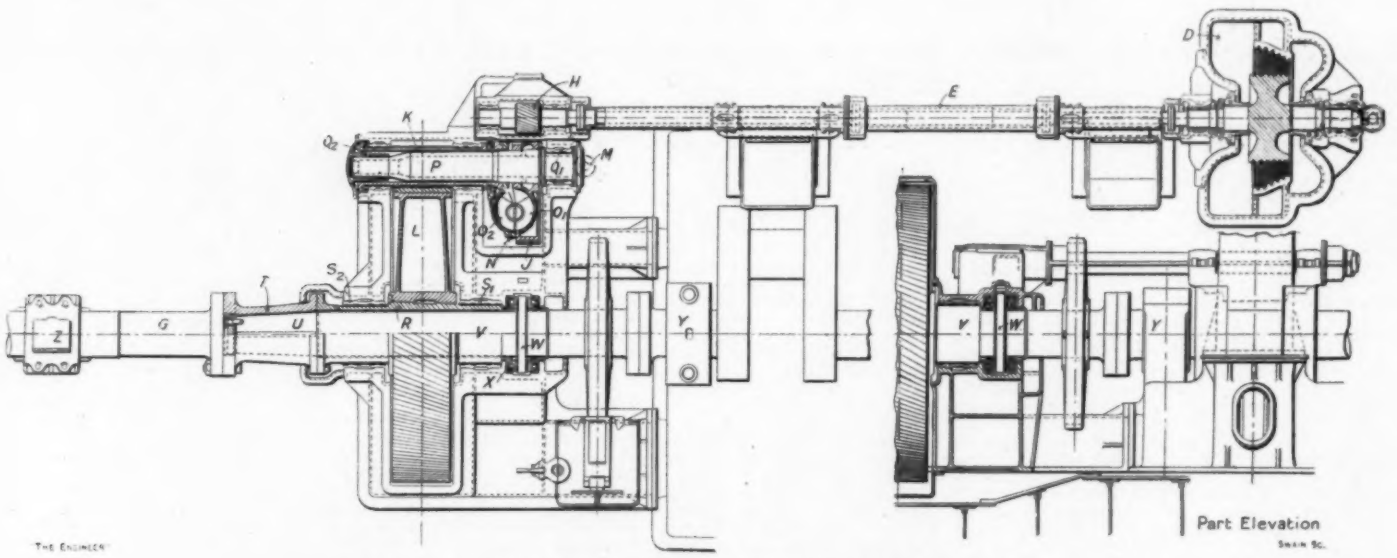


FIG. 3—PLAN AND PART ELEVATION SHOWING TYPICAL EXHAUST TURBINE DRIVE

cent. Between the two parts O_1 and O_2 there is a clearance of from ⅛in. to ¼in. The coupling has a twofold purpose, first, to enable a working together of the even turning turbine, and the uneven turning reciprocating engine, in that it does not transmit any unevenness of the turning moment; secondly, to enable an instantaneous cut-out of the exhaust turbine. That operation is done by the ring N, which, by being moved axially, permits the oil in the coupling to be thrown out through the holes in the circumference of the driving half O_1, so that the connection between the first reduction and the pinion K is at once broken. For re-connection, it is only necessary to close the holes by moving back the ring N to its working position and fill the coupling with oil through the pipe M. The emptying and filling of the Vulcan coupling can be carried out in a very short time.

As will be gathered from Fig. 3, the details of the gearing are as follows :—The driving half O_1 of the coupling is built into the intermediate gear wheel J, and this gear wheel is keyed to the shaft P, which is supported in the

journals Q_1 and Q_2. The driven half O_3 is keyed to the hollow shaft carrying the pinion K of the second reduction gearing, whilst this shaft is supported in two bearings —one beside the coupling half O_2 and the other beside Q_3. The support of the coupling halves with their gear wheels and pinions is, therefore, very rigid.

The main gear wheel L is not connected directly to the propeller shaft, but keyed to the hollow shaft R, which is supported in the large and rigid bearings S_1 and S_2. The crank shaft of the engine and hollow shaft R are connected by the long intermediate shaft V and the intermediate piece T, which is fixed to the shaft R by the cone U. The intermediate shaft V carries the single disc thrust block, which consists of the collar W and the bearing X. For disconnecting the whole exhaust turbine plant from the engine, it is only necessary to remove the flange bolts which connect the hollow shaft R with the intermediate piece T.

The main object of the arrangement incorporated in the hollow shaft R and the intermediate shaft V is to eliminate

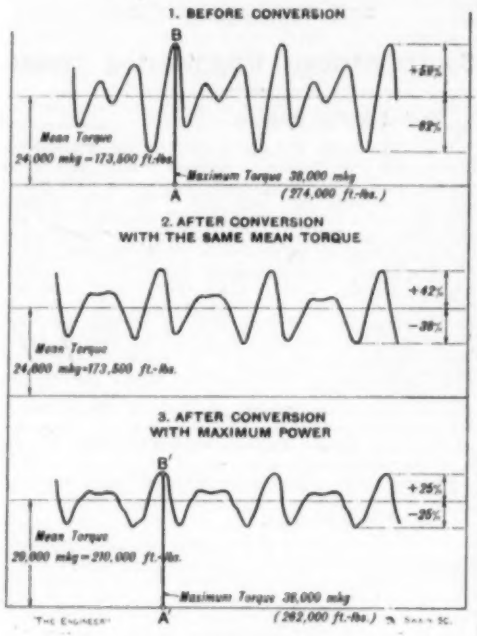


FIG. 4—TORQUE DIAGRAMS

from the main gear wheel the shocks of the engine occasioned by the reciprocating motion of its pistons and driving gear, and which are especially heavy when the main engine bearing at Y may be worn down. In this arrangement, the intermediate shaft V can move vertically relative to the hollow shaft R without detrimental effect to the bearings of the main gear wheel L. The intermediate shaft V is made long, so that, in the event of the mean bearing Y having a play of $^1/_{32}$in. over its whole circumference, the bending forces set up at U are only slight. The arrangement of the hollow shaft R and the intermediate shaft V has, we understand, given excellent results in practice, as none of the many ships already fitted with exhaust turbine installations have shown the slightest difficulties with any of the gear wheels or pinions.

As previously remarked, the turbine is cut out when the reciprocating engine is running astern. As the exhaust turbine only serves the purpose of increasing the output of the engine or decreasing its fuel consumption during

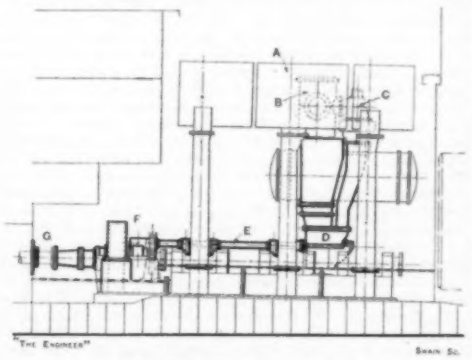


FIG. 5—ENGINE WITH TURBINE

unimpeded steaming periods, generally the reciprocating engine alone is used in harbours and narrow waters.

Among other designs described and illustrated by Dr. Bauer were examples in which the long intermediate shaft between the turbine and gear-box is done away with and the whole turbine and gearing aggregate compactly housed near the after end of the reciprocating engine. Other types of construction were also shown in which a simplified form of exhaust connection was made possible by placing the condenser inlet below the exhaust turbine flange. The sequence of starting operations was also fully dealt with and the automatic and emergency controls explained. A short section of the paper was devoted to the question of improving the condenser and the degree of vacuum to be aimed for, with a view of obtaining the most efficient working of the exhaust turbine.

With regard to the advantages to be obtained converting existing installations, Dr. Bauer deduces from actual manufacturing and installation costs the fact that in saturated steam installations working under normal conditions, the cost of an added exhaust steam turbine could be written off in three to four years with coal firing, and in one and a-quarter to one and three-quarter years with oil firing. For very economical installations already working with superheated steam, the time would probably be lengthened to four or five years with coal firing and one and a-half to two years with oil firing.

Under normal conditions the gain in speed would be for ships of 11 to 13 knots, 0·8 to 0·9 knot; and for 14 to 16-knot ships, 0·9 to 1·2 knot. The range of powers for which such a scheme would most likely find advantageous application would, Dr. Bauer thinks, be from 1000 to 6000 I.H.P. per shaft. As regards the future, the author's opinion seems to be that high pressure and high superheat installations with high-speed reciprocating engines, working in conjunction with exhaust turbines, will receive increased attention on account of their great reliability combined with an exceptionally low fuel consumption.

Power-Gas from Sewage Sludge.*

At the works of the Birmingham Tame and Rea District Drainage Board 400,000 tons of crude sludge, containing 8 per cent. of dry solid matter, are dealt with each year by the separate digestion of sludge process. The crude sludge is pumped into tanks set apart for the purpose. At the Saltley works are situated the primary digestion tanks, in which the sludge is retained for three months. It is then pumped to the secondary digestion tanks at a works more than 4 miles away. The sludge is retained in these tanks for a further period of two months, after which it is pumped on to drying beds. At this stage it contains about 12 per cent. of dry solid matter.

During the process of digestion about 25 to 33 per cent. of the dry solid matter is converted into a gas composed of 67 per cent. of methane, 30 per cent. of carbon dioxide, and 3 per cent. of nitrogen, having a calorific value of about 625 B.Th.U. per cubic foot. Most of this gas is given off in the primary digestion tanks, of which the total capacity is 147,000 cubic yards. Hitherto it has all escaped to atmosphere.

In 1921 Mr. John D. Watson, M. Inst. C.E., constructed a plant at the Colehall works of the Board, where a 34 B.H.P. gas engine driven by sludge gas has been in daily use ever since.

In 1925 the engineer to the Board, Mr. H. C. Whitehead, Assoc. M. Inst. C.E., had an exhaustive investigation made of this plant, to determine what amount of power might be expected from the much larger quantities of sludge available at the Saltley works. The quantity there from which gas might be collected economically was taken as 100,000 cubic yards. The results of this investigation are given in Table I. Mr. Whitehead commenced by installing at the Saltley works a 150 B.H.P. vertical gas engine, a 100-kW 4000-volt alternator, and 144 floating gas collectors, each 20ft. by 10ft. The success of the scheme depended upon the design and construction of a cheap and efficient type of gas collector.

TABLE I.—*Primary Sludge Digestion Tanks at Saltley Works. Total Capacity, 147,000 cubic yards.*

A. Gas used intermittently, some leaking to atmosphere, average of twelve months' results. B. Gas used continuously, allowing no opportunity for leakage, average of one month's results.	Results of measurements at Colehall works; quantity of sludge, 94 cubic yards.		Estimated figures for Saltley works; sludge covered taken as 100,000 cubic yards.	
	A.	B.	A.	B.
I.H.P. hours per week	193	270	205,000	287,000
I.H.P.	1·15	1·61	1.220	1,710
B.H.P.	—	—	915	1,280
kW	—	—	610	850
Cubic feet of gas (500 B.Th.U.) per annum at 15 cubic feet per I.H.P. hour	—	—	160,000,000	224,000,000
Cubic feet of gas (625 B.Th.U.) per annum	—	—	128,000,000	179,000,000
Value of gas (625 B.Th.U.) at 1s. 6d. per 1,000 cubic feet under collectors	—	—	£9,000	£13,400

The problem of collecting gas from a sludge digestion tank cannot be solved by roofing the tank completely, on account of serious difficulties enumerated in the paper. The principle of the floating type of collector of moderate dimensions was determined as the best to adopt, and experiments were carried out to observe the behaviour under practical conditions of the more suitable materials for construction. As a result of these experiments, it was decided to install a floating reinforced concrete gas collector for use with the first unit of the scheme, on account of low initial and maintenance costs, and efficiency in gas collection. The form adopted for the design was that of a raft, 20ft. long by 10ft. wide, bounded by vertical sides, extending 2ft. above the raft and 2ft. below, forming two open compartments, the lower for the collection of gas and the upper for providing the necessary displacement to float the mass. The gas is drawn off from a pyramid formed on the centre of the raft. The size of the collector is limited by its maximum permissible weight, which is about 8 tons in this case. When finished, a collector is slung by chains clamped to long bolts embedded in the four corners, lifted off the core mould by an overhead crane, and carried horizontally for lowering in the sludge. The mixture of concrete used is 4 parts of aggregate to 1 of ciment fondu. The collector is raised and launched when only 22 hours old, the two sides then acting as beams, 20ft. between supports, and each sustaining a dead load of nearly 4 tons. An output of one collector per diem from two moulds only has been maintained. The collectors are coupled in three blocks of forty-eight each, to give an estimated yield of 16,000,000 cubic feet of gas per annum.

The plant was officially put into service on September 29th, 1927, and has been running daily on full load since. The engine as supplied by the makers is quite standard, but certain adjustments have been made to suit the peculiarities of the gas.

Under the favourable conditions existing on the Board's works, the estimated production cost of current is 0·49d. per unit, effecting a net saving of over £1000 per annum for the first unit. The estimated cost of gas production on the basis of 16,000,000 cubic feet per annum from this unit is 7¼d. per 1000 cubic feet of gas with a calorific value of 625 B.Th.U. per cubic foot.

An abundant and cheap supply of power will seriously influence, if not completely control, future developments in the purification of Birmingham sewage. The estimated total available output of 10 million H.P. hours per annum is about five times the Board's present requirements.

* Abstract of a paper by F. C. Vokes and C. B. Townend, Assoc. MM. Inst. C.E., entitled "Power Gas from Sewage Sludge at the Birmingham Tame and Rea District Drainage Board," to be brought up for discussion at the Institution of Civil Engineers.

INSTITUTION OF MECHANICAL ENGINEERS.

A JOINT meeting of the Institution of Mechanical Engineers—North-Western Branch—and the Liverpool Engineering Society was held in the rooms of the latter, the Temple, Dale-street, Liverpool, on Wednesday, December 7th, when Mr. Hal Gutteridge read his paper on "Modern Portland Cement Plant."* Mr. Sterry B. Freeman, President of the Liverpool Society, presided. The reading of the paper was followed by a discussion, in which the chairman, Professor Mason, Professor Bannister, Messrs. E. A. Atkins, J. Wilding, C. A. Needham, T. Molyneux, and N. M. Broome took part. Mr. Freeman said that the use of pulverised fuel was being watched closely by marine engineers because if it could be adopted instead of liquid fuel a great many difficulties in connection with the firing of water-tube boilers would be solved. He asked the author whether there was any great difference between the types of burners used. Mr. Molyneux asked whether the cement manufacturers had yet arrived at a fineness of grinding which would make the cement in ordinary use approach failure in its results. Certain cements very finely ground had proved unsatisfactory in use. Other speakers referred to the effect of the ash produced by the powdered fuel burning. Professor Mason criticised the design and construction of the gyratory and ball-crushing mills employed in cement manufacture. Professor Bannister referred to American methods of filtration of the slurry before it was passed into the kilns. If they could extract some of the water from the slurry in that way without causing separation of the constituents it would be economical.

In his reply, Mr. Gutteridge defended the construction of the crushers by stating that reliability and regularity of working were more important than very high efficiency. With regard to American methods of filtration, he noted that waste heat boilers were being tried, but they had not been adopted in this country. Comparing the wet and dry processes of cement manufacture, he said that materials in the dry state could not be mixed with such a degree of certainty as when wet. As regarded the effect of the ash from the burnt fuel affecting the quality of the cement, he thought that the proportion was so very small that it could not possibly affect the tensile and compression tests to any measurable degree. In reply to the Chairman's question regarding the pulverised fuel burners, Mr. Gutteridge explained that they had come down to a standardised pattern in the cement industry. The coal was injected by means of a small fan, and was mixed with a large volume of air at a low pressure.

* An abstract of this paper was published in our issues of November 25th and December 2nd.—ED. THE E.

LAUNCHES AND TRIAL TRIPS.

TOFTWOOD, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Joseph Constantine Steamship Line, Ltd.; dimensions, 375ft. by 52ft. 6in. by 27ft. 9in.; to carry 7600 tons. Engines, triple-expansion, condensing, pressure 200 lb.; constructed by the builders; launch, November 24th.

PACIFIC ENTERPRISE, twin-screw motor vessel; built by the Blythswood Shipbuilding Company, Ltd., to the order of the Norfolk and North American Steam Shipping Company, Ltd.; dimensions, 450ft. by 60ft. by 42ft. Engines, twin sets of single-acting Diesel; constructed by John G. Kincaid and Co., Ltd.; trial trip, November 25th.

ZEALANDIC, cargo motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Shaw, Savill and Albion Company, Ltd.; dimensions, 500ft. long; 11,190 tons deadweight. Engines, twin reversible, single-acting, two-stroke Diesel; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, November 25th.

MIMIE, twin-screw steamer; built by Ferguson Bros. (Port-Glasgow), Ltd., to the order of the London, Midland and Scottish Railway. Engines, twin-screw; constructed by the builders; launch, November 29th.

KING EDGAR, motor vessel; built by Harland and Wolff, Ltd., to the order of the King Line, Ltd.; dimensions, 400ft. by 54ft. 6in. by 34ft. 8in.; 4536 gross tonnage. Engines, six-cylinder, four-cycle, single-acting Diesel; constructed by the builders; trial trip, November 30th.

PELAYO, motor vessel; built by Harland and Wolff, Ltd., to the order of MacAndrews and Co., Ltd.; dimensions, 270ft. by 39ft. by 17ft. 6in.; 1345 gross tonnage. Engines, six-cylinder, single-acting, Harland-B. and W. motor; constructed by the builders; trial trip, December 1st.

A Portable Petrol Engine Driven Drill.

THE drill operated pneumatically or worked by an electric motor has long since become a labour-saving device, almost indispensable to the structural engineer and shipbuilder and a useful tool in almost every engineering shop. The employment of such a tool, however, necessitates either a supply of compressed air or electric current, and there are many cases in which these desirable facilities are not at hand, and the nature of the work to be done does not warrant the putting down of special plant to meet the power requirements. In the article which follows we describe and illustrate a novel form of patented drilling machine which is driven by a small petrol motor and is complete with its own ignition apparatus and petrol supply tank. It was designed by Major P. C. Bird, of the Howard Pneumatic Engineering Company, Ltd., of Eastbourne and 25, Victoria-street, London, S.W. 1, and we recently had an opportunity of inspecting a machine under test conditions.

The complete outfit, as shown in Fig. 1, includes besides the drill a petrol tank and the box containing the accumu-

FIG. 1—DRILLING OUTFIT COMPLETE

lators and the Delco-Remy coils for ignition purposes along with the connecting leads and the fuel supply tube. Fig. 2 below clearly shows the drill mechanism with the clutch gear and engine. The engine is neatly enclosed in a casing and is mounted parallel to the axis of the drill so that there is room for the clutch and reduction gearing. It has two opposed cylinders with a bore of 42 mm., or a little over 1⅝in., and a stroke of 1½in. They have a total capacity of 104 c.c., giving an output of close upon 4 B.H.P. when running at 3500 revolutions per minute. By means of gearing the engine speed is reduced to 300 to 350 revolutions per minute at the drill, according to the size of drill to be employed. At present two sizes of machine, Nos. 3 and 4, are being built, which are suitable for ⅜in. to 1in. and 1in. to 1¼in. drills and weigh 38 lb. and 36 lb. For carriage to this weight there must be added that of the battery coils and fuel tank, which would probably double the weight we have given; but in setting up the machine the operator has only to deal with the actual weight of the tool, which is comparable with that of an ordinary pneumatic drill.

In the design of the engine several problems had to be met, which have been successfully solved. For the cooling of the engine cylinders a small fan is built into the centre of the fly-wheel and delivers air to the cooling fins on the cylinder head, which are enclosed in perforated cowls made of sheet metal. A simple two-stroke cycle with crank case compression is employed, and in the design we illustrate an open exhaust is used, which is directed in a downward direction by two short deflectors. While the engine so arranged may be satisfactory for outdoor work, it is recog-

FIG. 3—DRILL UNDER TEST

nised that some method of silencing will be needed for indoor work, and suitable exhaust pipes and silencers can be provided. Above the engine fly-wheel—see Fig. 2—will be seen the "kick" starter and the commutator. Below the crank case is the main pinion, which is mounted on an extension of the crank shaft, which is carried in ball bearings. This pinion meshes with the large gear wheel on the clutch shaft, the drive to the drill being transmitted through an internal band type of clutch operated by a central taper spindle under spring and hand lever control. The drilling unit itself is of the firm's standard pneumatic drill pattern and is built with a No. 3 Morse socket. A throttle lever "twist grip" type is used to control the speed of the engine, and the electrical connections are so arranged that when the throttle is on the off position the earthing connection is broken and there can be no wastage of current from the accumulators.

Reference may be made to the special type of carburetter which has been designed in order to meet the varied conditions under which such a drill might be called upon to work. The float chamber of the carburetter is arranged to swivel about the axis of the jet, which is always kept horizontal. When it is desired to drill in a sideways or upwards direction the float chamber is swung round to the required angle, the axis of the cylinders remaining, however, always parallel to the ground.

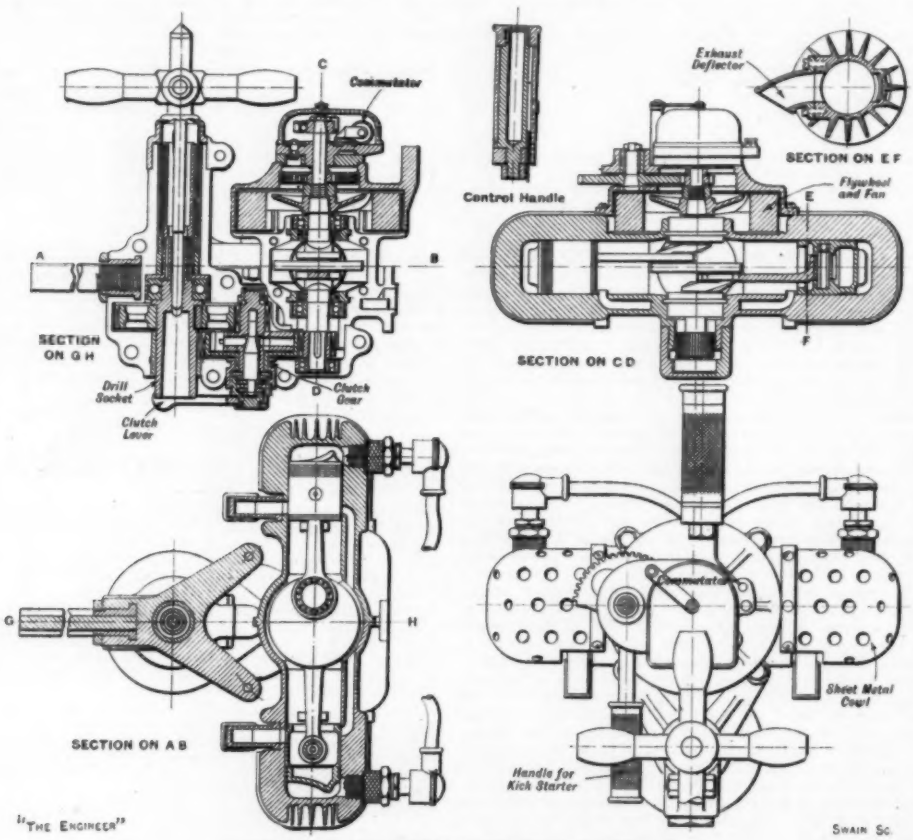


FIG. 2—SECTIONS THROUGH ENGINE AND DRILL

For conveying the fuel from the supply tank to the carburetter a length of rubber hose with a bore of ⅛in. is used. This tube terminates in a 1/32in. orifice, which has the effect, we learn, of compensating for any variation in height in the position of the fuel container. In order to lubricate the engine the makers recommend that about one-eighth of a pint of motor oil should be added to the gallon of petrol and the contents of the tank intimately mixed before starting work. Under ordinary conditions such a fuel supply will suffice to run the machine throughout the day. In the tests we witnessed, which were made with a No. 4 machine and a 1in. drill, there appeared to be plenty of power, and the drill could be fed forward at any desired speed without stalling the engine. The apparatus we have described is an interesting development of the pneumatic and electric portable tool, which should find application in a wide field, particularly that of railway construction and track work in which there is need for such a tool and for which service the drill has, we are given to understand, largely been designed.

South African Engineering Notes.

Central African Railways.

The Lake Victoria Branch of the Tanganyika Central line from Tabora to Mwanza is now open as far as Shinyanga, and it is reported that the first train should run into Mwanza early next year. This will establish communication for Lake Victoria with both Mombasa and Dar-es-Salaam. Next year should see the linking up of the Kenya-Uganda Railway with the Busoga Railway in Uganda, as well as a considerable advance in the extension towards the Nile, north of Lake Albert and to Kampala, the commercial capital of Uganda, while the extension of the Tanga Railway from Moshi to Arusha should be completed during the year. In 1928, also, work should be begun on the Zambesi Bridge. The generous offer of the Beit Trustees to provide the money for the construction of a combined road and rail bridge over the Limpopo at Liebig's Drift as a memorial to the late Mr. Alfred Beit has been accepted, so that both this project and the extension of the South African Railways branch line from Messina to a new point about a mile north of the river in Southern Rhodesian territory have received the necessary sanction.

Union Mail Contract.

The contract for carrying the overseas mails between the Union of South Africa and England has been held for a number of years by the Union-Castle Steamship Company, Ltd., but on its termination a couple of years back it was not renewed, because, owing to the growth of the Union's traffic in perishable exports overseas, the Government wished the new mail contract to include an undertaking to provide essential refrigerating and other space for the Union's trade in perishables. Owing to the increase of this traffic, the Government seem to consider it to be its duty to see that these expanding requirements are duly met by whatever line secures the mail contract. It is said that the Government also wants the mail contracting line to undertake considerable responsibility with regard to the carrying of the maize for export, and even wool. Unfortunately, the imports of the Union are not increasing in the same ratio as the exports, taking tonnage as the basis. No agreement was come to before or since the old contract expired, and at present the Union-Castle is carrying the mails under the old contract conditions, terminable by twelve months' notice on either side. The mail contractors receive a subsidy of about £225,000 per annum for carrying the mails. Of this, Britain pays £60,000, South Africa about £70,000, and the remainder is divided between some twenty or more other countries. Just now another effort is to be made to get a contract placed, and in connection with this Mr. Abbott, joint general manager of the Union-Castle Company, is visiting South Africa. There are others who are considering tendering, and the three chief competitors for the new contract will be (*a*) the Union-Castle Company, which is a member of the Conference Lines; (*b*) Sir Robert Thomas, chairman of the British and Continental South African Line; and (*c*) Mr. Tilden Smith, of London, and another well-known financier. It has also been suggested that the German East Africa Line may become a competitor, but as to that little is known at the moment. The Union-Castle Company, which has been building up its fleet for so many years, is exceedingly well placed to negotiate. Not only has it a splendid fleet of big steam liners, ranging from 12,000 tons up to 18,000 tons register, but it has recently put on the route the fine 20,000-ton motor vessel Carnarvon Castle, and has a sister ship well advanced in construction. Nevertheless, even that company would, it seems certain, have to expend considerable sums to provide the extra space, if success entailed providing tonnage for the perishable products, &c., to be carried, and no doubt it would have to be reimbursed over a period of years. On the other hand, rival tenderers would have to lay out enormous sums in any endeavour to supply transport for the country's needs. They would have to find such sums that it is hardly conceivable that they would enter into any undertaking unless the South African Government itself invested capital on their behalf in the building of new ships, a policy which would virtually mean State-owned shipping. It may be added that the big development in East Coast trade is probable if the movement for a closer union, leading to the federation of Uganda, Kenya, Tanganyika and Nyasaland, and possibly the Rhodesias, is successful. The Union Government, it is learned, is aware that the growth of this East Coast trade is likely to prove a factor of some importance in the forthcoming mail contract discussions.

South-West Africa Copper.

Although the copper deposits in South-West Africa have been known almost from the time when Van Riebeek became the first Dutch Governor of the Cape, and copper mining has been carried on in that part of the country for many years, and very successfully, the mining methods adopted have not kept pace with the times,

and were it not that the Namaqualand Copper Company and other mining companies were able, owing to the huge tonnages of ore available, to pursue a policy of selective mining, they would have been unable to continue so long as they did. When, however, the quantities of exceptionally rich ore had been worked up it was speedily evident that, unless up-to-date plants were installed, the ore, although even then running four and five times as rich as the greater part of the ore being profitably mined in the United States of America, could not be produced at a profit. Unfortunately, the companies feared to face the great expense necessary, and closed down, with one exception. It has been this timidness that has allowed American interests to obtain options over areas containing huge quantities of good payable grade ore. It is humiliating, from a British point of view, to note the bolder and wiser policy which has been pursued in what was, before the Great War, German South-West Africa, but which is now mandated territory with the Union of South Africa holding the mandate. None of the companies operating in that territory have done more for its development and the exploration of their concession areas than the Otavi Minen und Eisenbahn Gesellschaft, which commenced operations at Isumeb in 1905. With the completion of the railway to the coast in 1906, the company was enabled to increase its operations and make the first export of ore. Since that time operations have progressed steadily and the production and export of copper ore has grown tremendously. Considerable additions have, of course, had to be made to the plant and mine equipment at Isumeb from time to time, necessitating a large capital expenditure.

The latest construction at the mine and works has absorbed a sum of no less than £200,000, and this new plant and equipment, which is now nearing completion, will, when ready, increase the output of the mine to approximately 50,000 tons of high-grade ore shipped, and 100,000 tons of lower grade ore smelted, 20,000 tons of which will be passed through the concentrating plant. Three blast-furnaces, capable of handling this output, are now in operation. The most recent development in the mine has included the sinking of the main shaft and the sixteenth level winze to 1525ft., and attack on the ore body at the lowest level. Complete development of the four lowest blocks is proceeding.

Rustenburg Platinum.

The Government Mining Engineer in his report for 1926, in dealing with the platinum production of the Transvaal, states: "The main feature of the year, as far as platinum is concerned, was the discovery and exploitation of the Merensky Reef in the Rustenburg district. From Brits to Rustenburg northwards to the Pilandsberg and on to the Crocodile River, the Merensky Reef has been traced for 70 miles. Although naturally there are numerous patches where the reef is not payable, yet it is remarkably consistent in both width and value, and there would appear to be an almost inexhaustible supply of ore, carrying from 3 dwt. to 5 dwt. of platinum over a width of from 3ft. to 5ft."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Improved Prospects.

IRON and steel masters in the Midlands and Staffordshire have become more hopeful of the future as a result of a perusal of the trade returns for November. The increased proportion of the output of practically all the industries of the country going abroad, particularly of manufactured goods and iron and steel, has made a good impression, and could we substantially reduce the imports of iron and steel, the position would be even brighter. The rise in iron and steel goods exported is very cheering to industrialists in this area, being, as they were, valued at £6,465,741, against £3,708,819 a year ago, and £5,411,795 in November, 1925. The value of machinery exported last month, Birmingham manufacturers note, was £5,439,641, compared with just under £4,000,000 in the corresponding month of the two preceding years. The unfortunate fact revealed by the returns is the enormous tonnages of iron and steel we are still importing. True, we are making a little headway in the right direction, but the total quantity of iron and steel imported during November—284,764 tons, valued at £2,267,565—though it compares very favourably with the 422,679 tons valued at £3,249,817 imported in the corresponding month of last year, is still a serious matter for British producers. For the year to date the quantity imported has been 4,125,605 tons, valued at £31,790,809, compared with 3,223,144 tons and £25,623,254 in the preceding year. Local industrialists are hopeful that the balance of trade will continue to mend, and that next year will see further marked improvement in this direction. At the moment producers of iron and steel are experiencing considerable difficulty in disposing of their output. With the approach of the Christmas holidays, stocktaking, and the end of the year, consumers are restricting their buying to the lowest limits. Many users have pretty well covered their requirements for the remainder of the year, and are avoiding fresh commitments. The impression is now general that there will be comparatively little buying of material this year, and that forward contracts are not to be expected until the New Year. The flatness of business on 'Change in Birmingham to-day—Thursday—will therefore be readily understood.

Pig Iron.

Demand for raw iron continues moderately good for the season of the year, and some local furnacemen say they are well sold, and are not adding anything to stocks. Others, however, say they are not well placed and have some anxiety as to the near future. Production of Cleveland iron is reported to have stimulated that market, and in view of the competition between that district and Derbyshire, there is just a possibility that prices of the latter iron may become weaker. At present the price remains at £3 5s. 6d., with Northamptonshire £3 1s., and North Staffordshire about £3 6s. A few contracts have been made to the end of the year, but consumers are unwilling to negotiate beyond that period. The business is considered so speculative that negotiators generally demand larger concessions off current rates than smelters will entertain, even for the sake of comparative security. Pig iron output in the Midlands continues on a very restricted basis.

Finished Iron.

There is no material development in the Staffordshire iron trade. Marked bar houses are able to continue in operation, there being a fairly steady call for best iron, mainly for engineering and shipbuilding requirements. The price is maintained at £13. Crown bars can, it is claimed, be brought down to £9 5s., but South Staffordshire houses of high repute are unshaken in their quotation of £10 5s. to £10 10s. The Black Country nut and bolt works are better employed, thanks to a large demand from automobile engineers; but importers from the Continent are getting the bulk of the business. Staffordshire makers continue to ask £9 for nut and bolt and fencing iron. Tube makers are taking fairly large quantities of strip at £11 10s. Staffordshire ironmasters who are concentrating on re-rolling are doing a large business in re-rolled bars, which, as a rule, undersell the products of the big steel works.

Steel.

Steel demand is quiet, and makers who have thought fit to quote slightly higher prices for structural material have met with no response. This new tendency may be due to the stiffening of the prices of foreign material, consequent upon strike threats in Germany and as the result of the cartel proceedings. Continental quotations have shown a decidedly firmer tendency this week, billet quotations having risen to £5 7s. 6d. to £5 10s. delivered, steel bars to £6, and No. 3 Belgian iron bars to £5 19s. European works, however, are unable to promise delivery before January, whereas English mills are in a position to supply promptly. Staffordshire steel masters' quotations are unchanged at £8 7s. 6d. for ship plates and £7 12s. 6d. for joists. Hoops are maintained at £10 10s. at works. Small bars make £7 12s. 6d. upwards and soft billets £5 15s. upwards. Structural engineers in the Midlands state that business is rather quiet. Tenders are for small tonnages, but some large contracts are coming out for the State Railways of India and for South Africa, which it is hoped will provide good orders for the steel works later on.

Sheet Values.

The downward movement in galvanised sheets has not been arrested. Consumers at home have placed rather more business, persuaded apparently that present prices are unlikely to continue. Export buyers are still holding off, however. The f.o.b. quotation is £13 2s. 6d., but rather less has been accepted for substantial orders which fitted in with the rolling programmes of the mills. There is a fair demand for black sheets for the motor trade and various stamping requirements. It is interesting to note that exports of galvanised sheets continue to advance in value, last month's total of £1,094,563 comparing with £865,246 in the corresponding month last year, and bringing the total for the year to date to the value of £12,666,166, compared with £11,195,788 in 1926.

Scrap.

Heavy steel scrap continues cheap. Sellers are prepared to supply any quantity at £2 18s. 6d., delivered South Wales. This material is difficult to dispose of, but some sales of bright turnings at a slightly lower price are being made.

Coal Production in Staffs. and Worcs.

The following statistics regarding the output of coal in the Staffordshire and Worcestershire coalfields, given by the Secretary for Mines, are of interest to local industrialists. At the middle of November, 6000 wage-earners were employed at pits in South Staffordshire and Worcestershire, and the average weekly output during that month was 33,500 tons. The corresponding figures for 1924 were 6200 and 32,200 and for 1925 6400 and 33,900. During September—the latest period for which information was available—the estimated total weekly wage bill was £11,400. For both 1924 and 1925 the corresponding figure was £14,200.

Warwickshire Miners' Wages.

Wages in the Warwickshire coalfield have now dropped to the minimum. This district has held out against adverse conditions longer than any of the other coal-producing areas. It is, moreover, in a relatively favourable position to-day, for it has no deficit to carry forward, whereas in many other areas big debit balances have accumulated.

Motor Transport Business.

Some of the leading motor transport engineering firms in the Midlands are fairly well placed for orders, and can look to the future with considerable satisfaction. Of late the demand for heavy vehicles, such as are the speciality of one or two local firms, has increased by leaps and bounds, and Wolverhampton motor engineers are claiming a large share of the orders being given out. Guy Motors, Ltd., of Wolverhampton, has just received another big contract for the six-wheeled type of vehicles in which it has specialised. This is a repeat order for a fleet of seventy-eight vehicles of the four-cylinder and six-cylinder type for the India Office, similar in design to those subsidised by the War Office. In addition, orders have been received from business concerns in the country for upwards of eighty vehicles, ranging from 25-cwt. to 7-ton capacity and sixteen to seventy-two seaters. These contracts, I am given to understand, represent in the aggregate £135,000.

Midland Blast-furnaces Sold.

I learn this week that what are known as Pearson's blast-furnaces, Netherton, Worcs., which have been inoperative for some time, have been sold to a local firm for dismantling purposes.

Bio-Aeration Plant.

The Wolverhampton Corporation is about to install a second unit of bio-aeration plant at its sewage outfall works, at a cost estimated at £26,000. With this additional plant, the Corporation hopes to be able to deal with half the normal flow by this method of treatment.

Unemployment.

The returns showing the number of unemployed in the Midlands record another decrease, the current figure being less by 646 than that of last week. In both Birmingham and Coventry the position shows improvement, but at Wolverhampton there has been a turn for the worse. There are now unemployed in the Midlands 101,177 men, 26,462 women, 2834 boys and 2919 girls. To the total, the Birmingham area contributes 22,607, Coventry 3866, and Wolverhampton 3939.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Leaving the Irwell Undisturbed.

A LITTLE over twelve months ago the Salford City Council voted a sum of money for the purpose of securing expert engineering opinion as to the practicability or otherwise of the proposal to divert the river Irwell, the underlying idea being to utilise to better advantage than at present a fairly large area of land. A special committee which was set up referred the matter to Colonel F. Rayner, of Nottingham, for report. Colonel Rayner has now presented his report to the committee which considered it at a meeting last week. His opinion is that the carrying out of the work would probably involve the city in litigation, and perhaps heavy awards for compensation. Whilst realising the advantages to be derived from the scheme, he cannot, under the circumstances, advise its adoption. In view of the very definite nature of Colonel Rayner's report, the committee has decided that nothing more could be done in the matter, and the City Council will be notified accordingly. It is now expected that the proposal, which has been raised on numerous occasions in various forms during the last fifty years, will be abandoned.

Cables from Holland.

Further orders for cables have, on the recommendation of the Electricity Committee, been placed by Salford City Council with Dutch makers. In this instance the tender was one of £1700 received from the N.V. Nederlandsche Kabelfabriek, of Delft, for the supply of cable to British standard specification. In urging the adoption of the Dutch tender, it was stated that, compared with the lowest tender received from British firms, it represented a difference of 14·8 per cent. The Council was reminded that its policy in the matter of such a contract had already been decided. At the time of the decision the difference in price between the British and foreign tenders was 48 per cent., against 14·8 per cent. in the present instance. The narrowing of the margin, it was explained, was due to the fact that continental makers had raised their prices.

Cheshire Electricity Extension Scheme.

The area of supply of the new Joint Electricity Board for the urban areas of Wilmslow and Alderley Edge (Cheshire), it is now recommended, should be extended to include Chorley, Great Warford, Styal, Handforth, and a larger part of Nether Alderley than that served by the local company. It is regarded as likely that this recommendation will be agreed to. The Wilmslow and Alderley Edge Councils have decided to purchase all the properties of the company, and it is expected that cheaper current will be available. The question of applying for a special order under the Electricity Supply Acts is now being considered.

A New Vertical Retort Installation.

An installation of continuously operated vertical retorts on the Glover-West system at the Altrincham Gas-works has just been formally put into service. The plant is capable of increasing the gas production of the undertaking by 600,000 cubic feet a day, and by the expenditure of a comparatively small sum the plant can, it is stated, be extended to produce another 600,000 cubic feet when necessary.

Non-ferrous Metals.

Contrary to the experience recorded a week ago, when pretty well every section of the non-ferrous metals market had registered a substantial advance, all varieties during the past week have lost ground, and, on balance, are much lower at the time of writing than they were a week ago. The most serious decline has occurred in the case of tin. In the three previous weeks there had been a steady appreciation in values, but at the prices now ruling the whole of the advance made during this period has been wiped out. The explanation seems to lie in the reduced buying interest and in the improvement in available supplies of the metal. Under the circumstances the immediate future in this section of the market is extremely uncertain. Trade demand for copper during the past week has been on moderate lines. In the spelter market freer offerings, combined with the fact that consumers

during the previous week or two seemed to have bought sufficient to cover their requirements for the time being, have made for lower prices, and current quotations are now almost back to where they were a month ago. In spite of a fall of roughly 10s. a ton in the price of lead, not all of the improvement recorded a week ago has been lost. The Australian shipping strike had, of course, a bullish influence on the market, and with the settlement of the trouble there has been a certain amount of reaction. Lead supplies appear to be plentiful enough, more particularly as the demand during the last few days has eased off perceptibly, and further weakness would not be a matter for surprise.

Iron.

Users of foundry pig iron in this area have been putting out "feelers" in connection with contracts for the early part of next year, but they have not been numerous, and the general attitude at the consuming end of the trade seems to be a willingness to put off serious consideration of forward buying until the holidays are out of the way. So far as actual business is concerned this, during the week, has again been almost entirely a matter of small-scale buying for the purpose of tiding users over the next week or two. Under the circumstances, it is not surprising that the tendency of prices is easy, especially in Midland brands. These, if not back to where they were at the end of September, when the last buying movement set in, are within measurable distance of the prices that were then being asked. For delivery into the Manchester district, Derbyshire is quoted this week at from 73s. to 73s. 6d. per ton; Staffordshire at about 72s. 6d.; Middlesbrough at 78s.; Scottish at 88s.; and West Coast hematite iron at 84s. 6d. to 85s. There has been no expansion in buying activity in the case of finished iron, but prices remain at £10 per ton for Lancashire Crown quality bars and £9 10s. for seconds.

Steel.

Interest in the steel market, in view of the threatened labour trouble in the German iron and steel industry, has centred very largely on the position of imported materials. Earlier there was a pronounced disposition to "talk" prices higher, but the more hopeful tone of the cabled messages from Germany within the last day or two has tended to make the "bulls" rather less "bullish." In some cases the prices that are now being indicated are slightly firmer than they were a week ago, but there is not really a great deal of difference on the whole. The demand for semi-finished products is still very slow, but in imported finished steel a quiet business is being put through. Continental steel bars are at £5 18s. per ton; wire rods at £6 8s. to £6 9s.; angles at £5 17s. 6d.; joists at £5 12s. 6d.; Thomas plates at £7 2s. 6d.; Siemens plates at £7 12s. 6d.; billets at £4 17s. 6d.; and sheet bars at about £5 per ton, for cash against shipping documents, and including delivery to Lancashire works. Demand for British steel materials is still almost entirely of a hand-to-mouth character, with a marked absence of interest in forward buying. Boiler plates are easy at £10 5s. per ton, with steel bars at £7 10s. up to £8 10s.; ship plates at £8 7s. 6d.; and joists and sections at £7 12s. 6d.

Manchester Association of Engineers.

Thanks to the hospitality of the President, Mr. S. H. Heywood, a very enjoyable evening was spent by the members of the Manchester Association of Engineers and their ladies at a conversazione held at the Manchester City Art Gallery, on Friday last, December 9th. Few more attractive places could be found for gatherings of this nature than the Art Galleries, replete with one of the finest collections of art treasures in this country. The *soirée* was both large and representative, nearly everybody of note in the local engineering industries being present.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron market continues to be very unsatisfactory, and there are no signs yet of a revival of trade. Competition from the East Coast and further afield is having its effect upon local pig iron trade, and but for the fact that the local steel departments require considerable deliveries, there would be some further restriction in output. Furnaces are at work again at Carnforth, Ulverston, Askam and Cleator Moor. Customers are still confining their orders to immediate requirements. There has been a little foreign trade, but it does not amount to much, the principal dispatch of late being 1000 tons of special "white" iron to Germany. A certain amount of American business is offered, but the price is not tempting. The iron ore trade remains unaltered, but there is a little more activity in Cumberland, where, until a week or so ago, only one mine, the Florence, was being worked. Foreign iron ore is being marketed in restricted quantities, and there has been a cargo this week from Algeria. The steel trade is fairly well employed at Barrow, and for the time being the Siemens, rail, merchant, and hoop departments are fairly active. The first three are likely to be kept going for several months with present orders. The hoop department is likely to be well employed for some considerable time, as the contracts held are heavy.

Shipbuilding.

The Cumberland, one of the County Class cruisers built by Vickers, has been completed and was commissioned last week. She left Barrow on Saturday morning. No official particulars are available as to her performance on her various trials, but there is every reason to believe that the results have been highly satisfactory. The Orient liner Orford, which is now being fitted out in the Buccleuch Dock, Barrow, is rapidly assuming her final condition. No time is being lost in the completion of this vessel, for she is scheduled for service next April. She was launched in September.

NORTH OF ENGLAND.

(From our own Correspondent.)

Encouraging Outlook.

THE year is fast fading away with an industrial position regarded as very encouraging. It is true that a great stimulus is still required to bring about a normal level of activity, but the fact remains that the path of trade recovery has been entered upon, and the general outlook indicates a steady progressive improvement. A gratifying feature is the recovery that is taking place in the shipbuilding and marine engineering industries. During the past few weeks quite an unusual number of contracts for vessels has been placed, and several of the shipyards on the North-East Coast are assured of full employment over the whole of next year. In the iron and steel trades, too, the prospects are brighter. Nothing in the nature of a boom is anticipated or desired, but confidence in gradual trade development continues, and recent inquiries inspire hope of partial recapture of lost overseas trade, while home needs are expected to be heavier.

Cleveland Iron Trade.

Business for this period of the year, when seasonal quietness is expected, is on a fairly satisfactory scale. Some good sales are reported to have been made to consumers in Lancashire and South Yorkshire. The bulk of the make, however, is going into consumption at local steel works and foundries. Home firms at a distance are taking slightly better supplies of Cleveland iron, but overseas consumers are purchasing next to no iron here, and consumers in Scotland are not tempted to any extent by the preferential terms offered them to buy direct through the ironmasters' central selling agency. Lincolnshire pig iron makers are reported to be securing some of the Scottish trade, but the most formidable competitors for North-of-the-Tweed business are continental makers, who are still underselling there, the products of this district, by about 6s. per ton. Cleveland prices are unchanged, No. 1 foundry iron being 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d.

Hematite Pig Iron.

The supply of hematite pig iron is now only just sufficient to meet requirements. Additions to stock have ceased, and while makers are still prepared to sell at below recognised market rates, values are steadier. One furnace on hematite is being put out of blast at Pease and Partners' Normanby Ironworks, but two others, both on hematite, are to be re-lit at the adjoining Tees Ironworks of the same firm. This alteration will bring the number of blast-furnaces in operation on the North-East Coast to forty, of which twelve will be on hematite. Mixed numbers are 71s., and No. 1 quality 71s. 6d.

Ironmaking Materials.

Business in foreign ore is virtually at a standstill. Consumers have large stocks and big deliveries to take under running contracts. Sellers, however, adhere to quotations on the basis of best Rubio ore at 21s. 6d. per ton c.i.f. Tees. There is little new business moving in the blast-furnace coke trade. Good average qualities are obtainable at 17s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

Pending a more continuous flow of orders from the shipyards, certain sections of the manufactured iron and steel trade tend to be dull, though a good output is being maintained at the works. Foreign ship plates are being used on the North-East Coast at present to a considerable extent, and a further decrease in continental prices is announced. On the other hand, many firms are guaranteeing to buy British plates under the rebate scheme of the steel manufacturers. Steel prices are unchanged.

The Coal Trade.

Competition from Poland has been increasingly felt by Northern coal exporters to Italy this year, and the rumour that a number of industrial undertakings in Italy are jointly negotiating for 3,000,000 tons of Polish coal has caused some anxiety in Northern coal trade circles. Despite competition, the Northern counties have secured a fair share of the Italian trade, and the fixing of such a contract with Poland would undoubtedly be a serious matter. A more satisfactory piece of news is the fact that a contract has been placed for 25,000 tons of Northumberland steams by a Scandinavian consumer. During the coal strike this consumer was forced to contract for Silesian coal, and his contract has just run out. Reports to the effect that Poland, no longer able to meet British competition, contemplates abandoning the Scandinavian market, in which she secured so good a foothold last year, may or may not be well founded; but there are many indications that Northumberland and Durham coals are regaining pre-eminence in this important market, and that next year will show a decided improvement on this. Another significant feature in connection with the export trade is the possibility of the French import licence on coal being withdrawn at the end of the year. If the embargo, which came into force early in the year, were removed, it might help export trade from this district, although merchants do not seem to have experienced much difficulty in shipping coals to France. With the abolition of licences, the big utility companies in France would have greater freedom in purchasing, and they might prefer English fuel.

The Coal Market.

There is not a great deal of prompt business on offer on the Northern coal market, but as fitters in all sections are now very well booked to the end of the year, it is a question of securing supplies to suit particular shipment dates. An effort is being made to ship as much coal as possible before the holidays, and the prices are therefore easily maintained. The demand is perhaps not so heavy as in an average December, but the output is curtailed, so that, for the time being, supplies are immediately taken up. Best Northumberland steams are a much stronger market with contractors asking 13s. 9d. Direct the quotation is strong at 14s., with most of the collieries well booked to Christmas, and some as far as next March. There is a brisker inquiry for Tyne primes and second steams at unchanged prices, and steam smalls are fully steady at the late range of values. Durham steams, like those of the sister county, are firmer in tone, both for large and small. Gas coals are well booked, the leading qualities being in most request. Best Durham qualities command 15s. 6d. to 16s., and second kinds 13s. 6d. to 14s. Coking fuel shows signs of a spurt again, and 13s. 9d. is easily obtained for good makes, while bests are at 14s. Other descriptions are about 13s. 6d. There is a large demand for bunkers for ships' use, and recent figures are steadily quoted. The gas coke position is very quiet. Sellers have little to offer for this month. Buyers inquire moderately, but are not pressing, and consequently price movement is a question of actual loadings, but remains nominal at 24s. Patent oven cokes are quiet, and stocks fairly abundant. Good ordinary easy in tone at 17s. to 18s.; special makes, 23s. to 25s.; beehive coke, 26s. to 30s.

Miners Accept Wages Cut.

Settlements have been reached in the wages disputes, involving 2400 men and boys who were under notice at Whitburn Colliery, and the workmen at Harton Colliery, numbering 1500. The men's representatives have been given power to make a settlement with the owners of the collieries by accepting the terms proposed by them. This means that the men are prepared to agree to a reduction of wages, which is stated to be substantial, and also to certain changes in methods of working.

Singapore Floating Dock.

The last of the seven sections of the 50,000-ton floating dock for the British Admiralty for the new naval base at Singapore, was successfully launched during the afternoon of December 10th at the Wallsend shipyard of the builders, Swan, Hunter and Wigham Richardson, Ltd.

SHEFFIELD.

(From our own Correspondent.)

Quiet Conditions Continue.

THE influence of the holidays is now being fully felt. Buyers will not place anything but urgent orders, and deliveries, especially of raw materials, are at an exceptionally low point. It is impossible to say with any real confidence how things will move early in the New Year, but at least in regard to the bulk steel trade the prospects are none too good. Unless the prospects improve considerably between now and Christmas, which is not very likely, some of the furnaces may have to close down, and if they do they are are not likely to be recommissioned until the state of trade definitely warrants it. Basic steel is still the most depressed section. The production of pig iron has for some time been in excess of the sales, and stocks have accumulated at some of the ovens. Producers of both pig iron and steel, however, are inclined to the belief that conditions will improve after the holidays, and for that reason do not favour doing business far forward at the present low rates. Some of the finished branches have been buying considerably more material during the last few weeks in order to be well covered over the holiday stoppage. Otherwise business generally reflects the approach of the holidays. Heavy railway work is not exactly on the plentiful side, but the smaller classes of material, such as springs and buffers, are well ordered. Castings and other work for the electrical trades are in a steady demand and a good deal of steel is being produced for the motor car industry.

Lighter Industries.

The tool trades continue to hold their own, and though there is room to accommodate a good deal more work, conditions may be said to be fairly satisfactory. Quality continues to tell, and in some important markets abroad a strong preference is being shown for Sheffield products in spite of very keen foreign sales organisation. The seasonal business in the best qualities of cutlery and plate is now virtually ended. Although it is not viewed as completely satisfactory, there has for the past two months been a very large output of the best grades of cutlery, silver ware and high-class electro-plate. There has been considerable activity, too, in the cheap lines of plate and cutlery. These goods have been placed on the market in attractive forms, and have proved very popular. This class of trade is continuing briskly, and with orders still coming in it looks as though some of the works will be fully occupied up to the holidays.

Tool Heating Furnace.

A furnace for heating, sharpening and hardening tools has recently been placed on the market by the Hardy Patent Pick Company, Ltd., of Sheffield. It is intended particularly for tools which require to be sharpened frequently, such as picks, chisels, drills, wedges and similar small mining, contractors' and quarry tools. The furnace may be revolved on the tripod so that the tools to be dealt with are easily reached by the smith. The fuel required is small coke, breeze or coal, and it is stated that the draught is so easily regulated and uniform that a glowing red heat is maintained throughout the fire space, and it is impossible to burn the tools, even if a "heat" cannot be dealt with immediately. It is a portable furnace, and its capacity is twenty-four tools, in three tiers of eight holes each. Each tier is closed by a cover ring, so that only one or two tiers of holes may be used when the occasion only demands a moderate output, as, for instance, when the furnace is serving one blacksmith.

New Distilling Plant.

Arrangements have been completed by the Low Temperature Carbonisation Company, Ltd., which already

has a plant working at Barugh, near Barnsley, for the erection of a new plant at a cost of £200,000. This plant will be able to deal with twice the amount of coal now being treated at the existing works, and the daily by-products will be as follows :—350 tons of smokeless fuel, 2,500,000 cubic feet of gas, 10,500 gallons of oil and 1500 gallons of benzole.

Dutch Electric Cables.

Both the Rotherham and the Doncaster Corporations have decided to purchase electric cables manufactured in Holland. In the case of Doncaster, the tender accepted was that of Hogan and Wardrop for low-pressure cables manufactured by the Netherlands Cable Works, Delft, Holland, at the price of £824. It was stated that this course was adopted in the interests of economy. The nearest English tender was for £927. There was very slight variation in the prices of the English tenders. The chairman of the Committee said they did not want to be unpatriotic, and he hoped that British manufacturers would make it possible for them to give them the order without any fear of the Committee being taken to task for "paying through the nose." The Rotherham case concerned a quantity of cable to cost £4637. It has been the policy of the Committee to place orders in England, if the English tender is within 10 per cent. of the continental price. Opposing an amendment referring back the recommendation, a member of the Council said this was a matter of business, not sentiment. It was not the first tender they had let in this way. It had been the policy of the Committee to assist in endeavouring to break down the "ring" now in existence among cable manufacturers, and it was pleasant to note that they were succeeding. Some of the tenders they had received from the "ring" manufacturers had been as much as 30 or 33 per cent. over those of Dutch manufacturers. The only point was whether the cable was satisfactory for the Committee's purposes, and whether the workmen were being paid at the trade union rate of wages. They had satisfied themselves on the latter point.

SCOTLAND.

(From our own Correspondent.)

Oil from Coal.

IT has been said that the employment of a new process for coal treatment on a large scale is likely to find a beginning in Scotland. The starting of two large plants early in the New Year is being considered. This new process is apparently suitable for the treatment of bituminous duff or gum—which can be bought for about 2s. 6d. per ton to-day—and the yield of high-grade tar or oil from such material would be from 27 to 30 gallons per ton. Used in connection with Scottish shale, experiments show a gain in yield from 20 gallons obtained in standard practice to 26 gallons per ton with a drop in specific gravity from about ·85 or ·86 to ·775.

Steel Pipes.

Stewarts and Lloyds, Ltd., Glasgow, have secured a contract for steel pipes required for a new pipe line by the Water Committee of Torquay Town Council. The amount of the tender was £32,897.

Steel.

Business in most departments remains comparatively quiet, and the majority of the works are engaged well below capacity. Prices of plates and sectional materials are unchanged. An item of interest is the placing of a large order for steel rails on behalf of one of the Indian railways. Steel sheets are comparatively slow, especially the heavy gauges. Thin sheets move steadily without being really active. The demand for galvanised sheets has weakened, and export business might be done in the region of £13 12s. 6d. per ton for 24 b.g. corrugated.

Iron.

The bar iron works are still poorly employed, and the same may be said of the re-rolled steel bar department. Only immediate requirements are being considered and they are unusually low at present. Home prices are unaltered at £10 5s. for bar iron and £7 15s. per ton re-rolled steel bars, but in either case the export prices of £10 and £7 per ton respectively could be shaded for a favourable order. Pig iron is a very dull market. Outputs are very low, but more than sufficient to meet all demands. Stocks in makers' yards are increasing, and the number of furnaces in blast only amounts to thirty-one. Prices are unchanged.

Exports and Imports.

Arrivals of iron ore were rather larger than in the preceding week, the total discharged being 12,700 tons. Iron and steel from the Continent amounted to 1100 tons. Shipments of iron and steel were also better, amounting to 4900 tons. Fair quanitties of tubes, machinery and structural material were also dispatched.

Coal.

The Scottish coal trade is still without any change of importance. The export market is firm, owing to reduced outputs and the covering of sales by exporters. New business, however, is as slow as ever, and prospects are not improved by the decision of the Polish coalowners to intensify competition. Home demands remain below normal and in no wise make any recompense for the loss of export business. Aggregate shipments amounted to 266,153 tons, against 262,450 tons in the preceding week and 290,375 tons in the same week in 1925. The various Coalowners' Associations in Scotland appointed a sub-committee to consider the question of means to relieve the present depression, and they have now had laid before them a scheme which includes limitation of output, subsidisation of collieries closed down, and discrimination in the matter of prices between fuel for industrial purposes and supplies for sheltered trades.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

IT is usual in normal times for a spurt in activity to be seen in coal shipments as Christmas approaches, but unfortunately for the industry there is no evidence of it this year. The conditions remain quiet, and no hope of an improvement is looked for during the remainder of this year, or indeed during the early part of next. Exports of coal vary very little from week to week, as is shown by the fact that the total last week was approximately 415,000 tons, as against about 433,000 tons the preceding week. It is quite possible that the current week will be somewhat disappointing, as the tonnage position has been most unsatisfactory. At the end of last week there were fifty-six idle loading appliances at the various docks, and this week commenced with the number at forty-one, which shows that the arrivals of tonnage over the week-end were not up to the average. It is possible that a good percentage of the tonnage recently chartered has been delayed by bad weather, but even so it is too much to expect any great pressure when the delayed tonnage does come along. The inquiry for coals for early shipment has not shown any material expansion, but there has been more activity in operations ahead. It is now definite that the Brazilian Central Railways have purchased from one of the leading Cardiff undertakings about 200,000 tons of steam coal for delivery at Rio de Janeiro during the next four months, and it is stated that another well-known company has booked up about the same quantity of best Admiralty large coal at 18s. 9d. f.o.b. There is every reason to believe that two of the large firms interested in foreign coaling have purchased from one colliery concern 650,000 tons of Admiralty large for delivery over next year, one lot of about 500,000 tons being at the price of 17s. 10½d. and the other of 150,000 tons being at 18s. f.o.b. It is interesting to note that the current year's contracts for the same coal are 20s. 6d. and 21s. per ton f.o.b. The prices now accepted for coals over next year are, of course, low, and with the irregular working at the collieries, must be unremunerative, but the only hope of the collieries is that business will improve and that they will be able to hold out for higher figures.

Centralised Buying.

The rumour was current last week that a movement was on foot in Italy for the centralised buying of all coal required by that country. Since then the South Wales Coal Exporters' Association has circularised its members informing them that a leading Genoa newspaper has published an article on this subject, stating that the General Commission for Combustibles which is examining the coal problem has discussed the method of compensating with an increased exportation the sums which Italy pays to foreign countries for the necessary importation of coal. The article states that "the Central Commission has taken some decision in this sense, but something more is required. It will be necessary in substance that the coal consumers should be formed into a section of the institute for exportation in order to co-ordinate the requests and to combine the various consumers of the different qualities." After dealing with the quantities of coal consumed by the various undertakings in Italy, the article points out that the Commission should take intense action with the nations which chiefly export coal, and especially with Britain, which country has the greatest interest to export her coals to Italy, so that the exportation of coals into Italy may be compensated as far as possible by an equal value of importation of Italian products. It may be added that this is not the first time that such a proposal as a centralised buying agency has been suggested in Italy, but there is no doubt that the strongest opposition to it will be forthcoming, and that developments will be closely watched by the South Wales Coal Exporters' Association.

Miners' Wages.

Reference was made last week to the claim of the South Wales coalowners for a reduction of the minimum percentage and variation of the subsistence wage, together with the counter claim of the South Wales Miners' Federation, to operate as from January 1st. A meeting of the Conciliation Board for the coal industry was held at Cardiff on Monday, when the parties failed to come to an agreement, and it was therefore decided that Sir Francis Taylor, K.C., K.B.E., the independent chairman, should be invited to preside at an adjourned meeting, when the proposals will again be discussed. The Board was informed that the independent chairman could attend on Wednesday, the 21st inst.

Trimmers' and Tippers' Hours.

A conference between the representatives of the Great Western Railway Company and the employing interests, together with the representatives of the coal trimmers and tippers, took place at Cardiff on Tuesday to consider the application of the workmen that night work at South Wales docks should be abolished. The proposal is that the present split shifts which were introduced early this year should be replaced by two continuous day shifts. The employing interests are opposed to this change, and no agreement was arrived at. It was decided that the matter should be referred to the National Trimming Committee in London for consideration.

Ship-repairing Conditions of Employment.

Negotiations have been going on between the employers in the ship-repairing and engineering industry of this district for a year or more to bring about reduced working costs, and to introduce revised working rules, but recently the members of the Amalgamated Engineering Union in a ballot rejected the proposals. It is now stated, though no official information is so far forthcoming, that the Employers' Federation is opposed to making any further concessions, and that it is its intention to put the new rules into operation as from the beginning of the New Year.

Tin-plate Pool.

It is announced that the stabilisation scheme in the Welsh tin-plate trade has now been definitely adopted to operate as from Monday last. The minimum selling price is 17s. 9d. basis f.o.b. works port, and under the pooling scheme the works will stop three weeks in every thirteen weeks, but the report is current that some of the tin-plate works will close down for a whole week at Christmas and others for a couple of days only.

Order for Ship Plates.

The Dowlais Works at Cardiff belonging to Guest, Keen and Nettlefolds have just secured an order for 1000 tons of steel ship plates, to be used for two steamers of 9000 tons, which are being built by the Northumberland Shipbuilding Company (1927), Ltd., for Sir William Seager and his sons. The contract was placed in Cardiff through the instrumentality of Sir William Seager.

Docks Work at Christmas.

The South Wales Area Trimming Board, together with the Great Western Railway Company's representatives and the tippers, have agreed that the official Christmas holidays for coal trimmers and tippers at South Wales ports shall be Monday and Tuesday, the 26th and 27th inst., full work to be resumed on Wednesday, December 28th.

Current Business.

There has been no variation in the steam coal market, and business has been quiet generally. Values of both large and small coals have remained practically stationary. It has been decided that the workmen in the coalfield shall have two days' holidays at Christmas, viz., the 26th and 27th inst., the night men to return on Tuesday night.

CATALOGUES.

BARFORD AND PERKINS, Ltd., Peterborough.—Catalogue of light motor rollers.

PAUL DIENY, 317, High Holborn, W.C. 1.—Particulars of the type A "Frisch" lubricator.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Publication No. 222, dealing with Prescot disconnecting network boxes.

ELLIOTT BROTHERS, Ltd., Lewisham, London, S.E. 13.—Additional sheets for the main catalogue dealing with indicators and meters.

GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, W.C. 2.—Particulars of G.E.C. lighting for shops, stores, offices, factories, &c.

BURMEISTER AND WAIN, Ltd., Copenhagen, Denmark.—"Some Facts about the Burmeister and Wain Diesel Engines and Motor Ships."

ALEXANDER WRIGHT AND CO., Ltd., 1, Westminster Palace-gardens, S.W. 1.—Pamphlet illustrating the Summance patented "dead-beat" pressure indicator.

THE NATIONAL STEEL FOUNDRY (1914), Ltd., Kirkland Works, Leven, Fife.—Booklet illustrating various classes of steel castings made for the automobile industry.

THE HOFFMANN MANUFACTURING COMPANY, Ltd., Chelmsford.—Folder illustrating a large number of industrial machines of all types using Hoffmann bearings.

THE MIRRLEES WATSON COMPANY, Ltd., Scotland street, Glasgow.—Pamphlet describing the Delas-Ginabat condenser now being made by the company for land and marine services.

J. W. JACKMAN AND CO., Ltd., Blackfriars-road, Manchester.—Book entitled "The Cleaning of Metallic Articles," describing the firm's latest sand blast and tumbling barrel equipment.

THE ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C. 2.—Two new publications dealing with light-weight traction motors and the Seewar governor gear for impulse water turbines.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Publication No. 1123 describing the firm's heating and ventilating systems and illustrating a number of installations.

REAVELL AND CO., Ltd., Ranelagh Works, Ipswich.—Pamphlet illustrating the "Reavell" quadruplex air compressor for coupling direct to electric motors or high-speed steam or internal combustion engines.

JAMES ARCHDALE AND CO., Ltd., Ledsam-street, Birmingham.—Particulars of the Archdale continuous rotary milling machine, list M.D. 1, multiple spindle drilling machines and attachments, and sheet S.M. 1 describing a honing machine.

DAVID BROWN AND SONS (Huddersfield), Ltd., Lockwood, Huddersfield.—The last of the three volumes "Worm Gearing." "Double Helical Gearing," and "Spur Spiral and Bevel Gearing," a series of treatises devoted to the design, manufacture and application of gearing in its various forms. Each of these books can be obtained for the nominal sum of 1s.

MANAGEMENT GRAPHICS.—In a lecture on "Management Graphics," given before the Junior Institution of Engineers on December 9th, Mr. T. G. Rose said that too often was it found that there was no proper system of control of general management and internal administration. Many recorded figures were useless, information which was really vital was not available, and no effort was made to investigate cycles or trends, or cause and effect, so that the loyal efforts of subordinates were often nullified by a vagueness of policy and ignorance of facts amongst those in control. All sound management was based on comparison of results; the mere noting of a result was usually of little interest. Since in any business the results of different departments were bound to influence each other, and in many cases the relation of the result of one department to that of another was of great importance, it followed that unless some clear pictorial form of regarding these results were used, the difficulty of following figures from column to column became so great that comparisons were impossible. Mr. Rose said that there were very few statistics which could not be shown with advantage as trend charts, and by superimposing two trend charts, each showing actual results, cumulative results, and the moving annual total, an immediate answer could be obtained to the question, Are we doing better or worse than last year? and no amount of statistics or schedules could be as effective or telling. In order to show that the methods which he advocated did not lead to an excessive accumulation of squared paper, Mr. Rose held up for all to see the book of modest size in which he kept the graphic records of his own business.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 16 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 10 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 6 to 3 1 0	
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 6 to 3 6 0	
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 4 0 (a) / 4 7 0 (b) / 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 10 0 to 10 0 0	
Marked Bars (Staffs.)	13 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	£13 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
MANCHESTER—		
Bars (Round)	8 10 0	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	10 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 0 0	—
MIDLANDS—		
Small Rolled Bars	7 12 6 to 8 0 0	
Billets and Sheet Bars	6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 2 6 to 13 10 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	266 17 6
,, (three months)	263 7 6
Copper (cash)	59 10 0
,, (three months)	59 13 9
Spanish Lead (cash)	21 17 6
,, (three months)	22 3 9
Spelter (cash)	26 2 6
,, (three months)	25 18 9
MANCHESTER—	
Copper, Best Selected Ingots	66 7 6
,, Electrolytic	67 0 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price), lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
,, Condenser, lb.	0 1 1½
Lead, English	23 10 0
,, Foreign	22 7 6
Spelter	26 10 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 17 6	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 10 0	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 0 0	11/6
,, ,, ,, 1 p.c. carbon	£41 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£53 0 0	17/6
,, ,, ,, carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£12 0 0 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	17/- to 18/6
,, ,, Trebles	14/6
,, ,, Doubles	14/- to 14/3
,, ,, Singles	11/9 to 12/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
,, ,, Jewel	15/6
,, ,, Trebles	14/3
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/-
Screened Navigation	18/-
Trebles	14/3 to 16/6
Doubles	14/3
Singles	11/9 to 12/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/6
Secondary Steam	12/3
Trebles	14/3
Doubles	14/3
Singles	11/9 to 12/-

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	24/- to 25/-
Household	40/- to 56/-
Coke	22/6 to 23/6
NORTHUMBERLAND—	
Best Steams	13/6 to 14/-
Second Steams	12/9 to 13/-
Steam Smalls	9/- to 9/9
Unscreened	13/- to 13/6
Household	21/- to 27/-
DURHAM—	
Best Gas	15/9
Second	13/9 to 14/-
Household	21/- to 27/-
Foundry Coke	19/- to 26/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/- to 20/6 —
Screened House Coal	16/- to 17/6 —
,, ,, Nuts	15/- to 16/- —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/- to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	11/- to 12/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	16/6 to 17/6

(9) SOUTH WALES.

CARDIFF— Steam Coals:	
Best Smokeless Large	19/- to 19/6
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/6 to 18/-
Western Valley Large	17/- to 17/6
Best Eastern Valley Large	17/- to 17/3
Ordinary Eastern Valley Large	16/6 to 17/-
Best Steam Smalls	12/- to 12/6
Ordinary Smalls	11/- to 12/-
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/9 to 15/3
No. 2 ,, Large	16/3 to 16/9
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/6 to 12/6
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	22/6 to 24/-
Pitwood (ex ship)	28/- to 28/3
SWANSEA— Anthracite Coals:	
Best Big Vein Large	32/- to 34/-
Seconds	26/- to 29/6
Red Vein	20/6 to 25/-
Machine-made Cobbles	35/- to 40/-
Nuts	38/6 to 42/6
Beans	22/6 to 28/-
Peas	17/- to 19/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	7/9 to 8/3
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	9/9 to 10/9
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Engineering.

WORK is very unequally distributed in the engineering shops, and, in view of the decision of the Government and the railway companies to postpone the carrying out of constructive undertakings, the situation is becoming worse. Moreover, the intention of the Government to make still further use of German reparations is held to prejudice seriously the situation of French engineering firms, which, however, will probably get work that would otherwise not be available if it were not possible to carry out urgent works with the aid partly of German material. Makers fully recognise that the Government is tackling a serious financial problem, apparently with success, but they believe that a long time will elapse before finances can be adjusted sufficiently to allow of a revival of industrial activity. Meanwhile, locomotive builders have received some orders, the shipyards are a little more active, but the only firms which are really busy are those engaged in the manufacture of war material, principally for foreign Governments.

The Steel Cartel.

The meetings that were held in Brussels during last week showed that steel makers continue to manœuvre with the idea of securing further advantages. Finding that they were involved in heavy penalties through exceeding the quota allotted to them in order to supply home needs, the Germans asked that the quotas should be increased all round, and they were supported in that claim by Austria and Czecho-Slovakia; but it was decided to postpone a discussion on this matter, as well as upon the German proposal to reduce the amount of penalty, until the meeting in Paris in March next. For the first quarter of 1928 the production of steel is to remain unchanged. No progress could be made with the constitution of the *comptoir* for the sale of rolled sections. After all the countries had agreed to the quotas, France obtained an increase of 15 per cent. for the new mills which have been installed in the devastated regions, whereupon the Belgians insisted upon France and Germany providing some compensation by undertaking to abstain from sending rolled steel to Belgium. The German and French mill-owners refused to give this promise, and the negotiations again fell through.

The Nice-Coni Railway.

Started twenty years ago, the railway between Nice and Coni in Italy is now nearing completion, and will be officially opened in June next. It puts the Riviera into direct communication with the North of Italy and with Central Europe through the St. Gotthard and Simplon tunnels. On Italian territory, the single track line has been in service for some years, but from the frontier to Nice, a distance of 36 miles, the construction was frequently interrupted, and it was only two or three years ago that a determined effort was made to complete an undertaking which threatened to drag along interminably. In view of its length, the railway offered probably more engineering problems than any other in the country. It has more than twenty bridges, viaducts and other works to carry the railway through a tortuous region of the Alps. At L'Escarène there is a viaduct with eleven arches 40 m. high. Then comes the Braûs Tunnel, which is the longest in France, its length being 5939 m. The Bevera Viaduct has four arches, joining a metallic bridge 90 m. long. There is an important bridge at Saorga and another at Scarassoui, which carries the line across the river Roya at a height of 45 m. Finally there is the spiral tunnel of Berghe, which has a length of 1886 m. Between Sospel and Breil the line passes through a tunnel under Italian territory, and at Breil a branch line has been constructed to Vintimiglia. An important international station is being built at Breil, while the frontier station will be at Foutan.

Oil Importations.

The Bill modifying the legislation concerning the importation of oils has been published, and is now being examined by the Commission des Pétroles. It is less restrictive than the Bill originally proposed, although import licences will still have to be obtained, and the import duties are so arranged as to favour the home-refining industry, while a close supervision will be exercised over all operations. It has been suggested that the Bill will still leave a monopoly in the hands of importers, but the Minister of Commerce, M. Bokanowski, affirms that the law offers a guarantee to independent companies against the operations of trusts, and that the conditions under which licences are granted will insure a normal competition.

The Makhonine Oil Fuel.

About two years ago a great deal of prominence was given to a new system of carburetting invented by a Russian engineer, M. Makhonine, which was said to be capable of producing spirit direct from heavy oils for motor cars, and it was declared that tests on military lorries and tractors had given satisfactory results. The Government affirmed that it provided a solution of the problem of rendering France independent of foreign supplies of petrol for purposes of national defence. Outside the Government the new process was viewed with scepticism, and as M. Makhonine refused to allow engineering and scientific bodies to make independent tests, nothing more was heard about the matter. Since then the carburetter appears to have dropped in the background, and M. Makhonine is again to the fore with a new fuel, for which special claims were made during the debate in the Chamber of Deputies on the War and Navy Budgets. M. Makhonine affirms that he can produce a million tons of spirit from five million tons of inferior coal, and it was asserted during the debate that trials carried out in the Navy had given satisfactory results. This was contested by the Minister of Marine, who stated that the experiments had revealed several defects in the Makhonine fuel.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

279,635. October 29th, 1926.—TURBINES DRIVEN BY A MIXTURE OF STEAM AND WATER, E. Bräuer, Kunz-Buntschuh Strasse 4, Berlin-Grunewald, Germany.

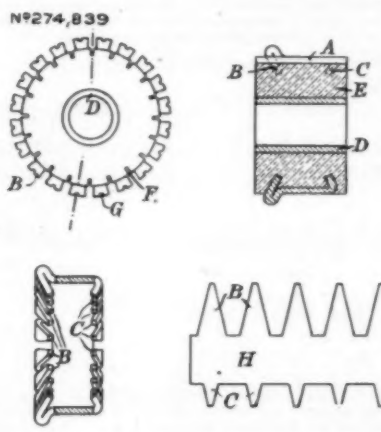
The inventor proposes to operate an impulse turbine by means of an intimate mixture of steam and water, or "fog," as he calls it. The fog is produced by passing hot water through an expanding nozzle as shown in the drawing. The cross-sectional area of

the throat of a nozzle to provide about 120 horse-power is 0·25 square centimetre, the final area of the nozzle is 45 square centimetres, and its length 200 centimetres. The initial pressure is 200 atmospheres and the outlet pressure 0·2 atmosphere. The water must not be heated to the critical temperature of 374 deg. Cent. In these conditions the inventor claims a higher thermal efficiency than is possible with saturated or superheated steam.—*November 3rd*, 1927.

DYNAMOS AND MOTORS.

274,839. June 29th, 1927.—IMPROVEMENTS IN COMMUTATORS FOR DYNAMO-ELECTRIC MACHINES, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

A commutator constructed in accordance with this invention consists of a copper collar A with radial hooked-shaped projections B and C, and a bush D embedded in an insulating mass

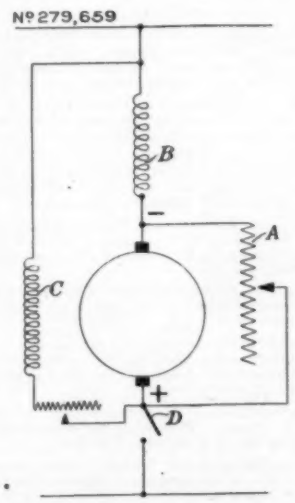


E, such as Bakelite. Longitudinal saw cuts are made in the collar, so that copper segments are separated from one another by grooves F. The projections B are also provided with slots G for the reception of the ends of the armature windings. The projections B and C may be stamped out of a flat copper band H and then pressed into the form of hooks when the band is bent into a ring to form the collar.—*November 10th*, 1927.

TRANSFORMERS AND CONVERTERS.

279,659. November 30th, 1926.—IMPROVEMENTS CONNECTED WITH THE STARTING OF MOTOR CONVERTERS, *The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2; and Giulio Schroeder.*

For the purpose of facilitating the starting of motor con-

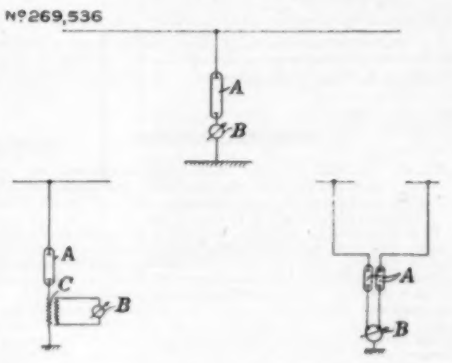


verters by the application of power to the alternating-current side of such machines a resistance A is provided which, during the starting period, is connected across the direct-current armature terminals so that current may flow through the commutator and brushes to and from the resistance. By this means the voltage induced in the rotor of the alternating-current element of the machine is divided between the windings in which it is generated and the windings of the direct-current part in a different proportion from that which would exist otherwise, the direct-current part taking more voltage than would be the case if there were no resistances connected across the brushes. This resistance may consequently replace wholly or in part the resistance connected through the slip rings to the alternating-current rotor winding. In the diagram the starting resistance is indicated at A, the commutating pole and compensating windings at B, the shunt winding at C, and the main direct-current switch at D.—*November 3rd*, 1927.

MEASURING AND TESTING INSTRUMENTS.

269,536. April 9th, 1927.—IMPROVEMENTS IN AND RELATING TO HIGH-TENSION MEASURING DEVICES, *International General Electric Company, Incorporated, of 120, Broadway, New York, United States of America.*

For measuring high voltages in accordance with this invention a high resistance, ionised gas tube is connected directly to the system so as to form a series resistance for reducing the voltage.

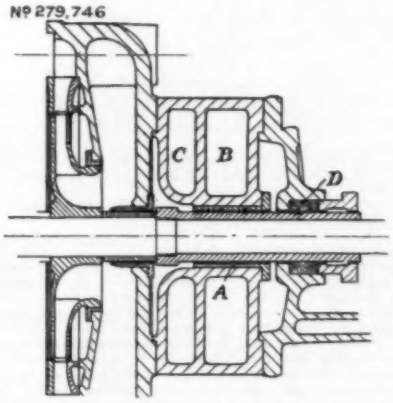


The upper diagram shows a single tube A used for this purpose, the indicating instrument being shown at B. In the lower right-hand diagram an arrangement involving the use of two tubes is shown; whilst in the lower left-hand diagram a transformer C is employed, in addition to the tube. In this case the scheme is, of course, only applicable to alternating-current systems.—*November 3rd*, 1927.

PUMPING AND BLOWING MACHINERY.

279,746. June 23rd, 1927.—STUFFING-BOXES FOR CENTRIFUGAL PUMPS, G. Weyland, Lambsheimerstrasse 40, Frankenthal/Pfalz, Germany.

This stuffing-box arrangement is specially intended for centrifugal pumps used to deliver high-pressure, high-temperature water for boiler feed. A bushing A is arranged round the shaft

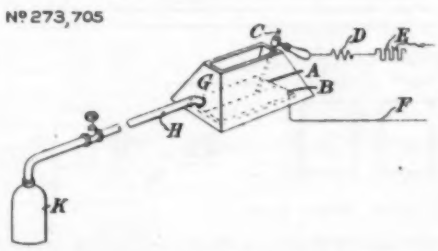


and allows a very slight leak away of water from the pump casing. This bushing is surrounded by a jacket B through which cold water is circulated. An insulated space C prevents loss of heat from the pump casing. An ordinary stuffing-box filled with soft packing is arranged at D, and, it is claimed, works under conditions no more adverse than those of a normal pump.—*November 3rd*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

273,705. June 27th, 1927.—IMPROVEMENTS IN AND RELATING TO ARC WELDING, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.

This invention relates to electric arc welding in a gaseous

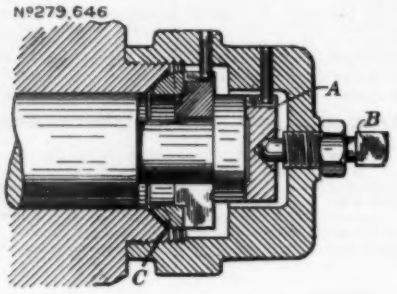


medium, and the object is to produce sound welds. In the example illustrated the work consists of a pair of plates A and B. The electrode C is held in a holder, which is connected to the supply circuit through a reactor D and a resistance E, whilst a lead F connects the work to the other pole of the supply. A hood G composed of asbestos encloses the work. A gaseous medium

is conducted to the hood through a pipe H from a container K.—*November 3rd*, 1927.

279,646. November 9th, 1926.—SCREW-CUTTING LATHES, R. E. Holbrook, 44, Martin-street, Stratford, London, E. 15.

The aim of this invention is to minimise periodic errors in the lead screws of lathes. The thrust of the screw is consequently

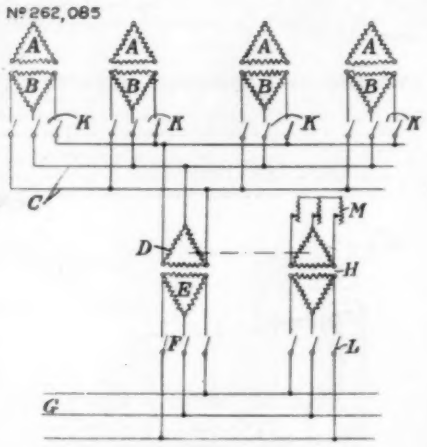


taken, in one direction, by the washer A, which is free to oscillate about the round ended screw pivot B. In the opposite direction the thrust is taken by the spherically seated ring C.—*November 3rd*, 1927.

MISCELLANEOUS.

262,085. November 15th, 1926.—IMPROVEMENTS IN AND RELATING TO SYSTEMS OF ELECTRIC TRANSMISSION, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

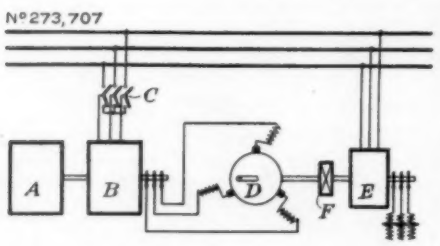
This specification describes a method of starting induction motors, and more particularly machines operated at a relatively high frequency. Such machines are specially suitable for driving spinning, twisting or doubling frames for artificial silk, viscose, or other textiles. If an asynchronous motor is adopted to run at a constant speed with a minimum slip its starting torque is poor. The object of the invention is to provide improved means for starting asynchronous motors, and it makes use of a frequency changer which supplies the motor with current at or above the frequency of the alternating-current source as desired. Four 100-cycle induction motors are shown in the diagram. A represents the closed-circuit rotor winding of each motor and B the stator windings. The bus-bars C are connected to the rotor wind-



ing D of a slip-ring asynchronous machine having a stator E, which is excited when the switch F is closed from the exciting mains G. H is the driving motor. Means are provided for holding the rotor D. Let it be supposed that the current in the mains G has a frequency of 50 cycles per second and that the motors are designed to operate at 100 cycles per second. When starting, the switches K of the motors which are required to work are first closed and the rotor D is held at rest. The machine D E then simply acts as a voltage transformer. Each motor will then exert a relatively high starting torque. When synchronous speed is reached the switch L can be closed and the motor H then starts, and it drives the rotor D in the opposite direction to that of the rotating field. Current is then supplied to the motors A B at a frequency which is above that of the mains G, and it increases with the speed of the motor D E. The speed, and consequently the frequency, can be adjusted by the rheostat M.—*November 3rd*, 1927.

273,707. June 27th, 1927.—ARRANGEMENT FOR DRIVING ASYNCHRONOUS MOTORS WHICH HAVE TO BE RUN AT TIMES WITH A VERY LOW SPEED, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.

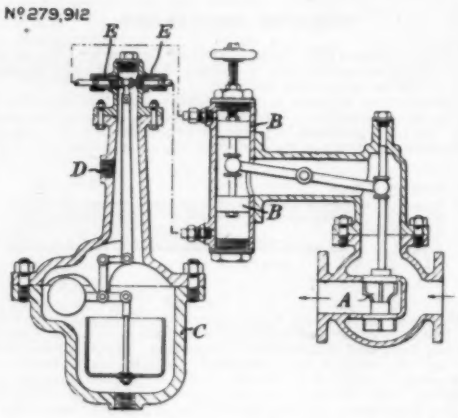
For the driving of paper calenders asynchronous motors are frequently used, as during the normal working the calenders always run with the same or approximately the same speed.



In drawing the paper into the calender it is, however, necessary that the calender should be driven at a very low speed which amounts to, say, 5 to 10 per cent. of the normal speed. Moreover, it should be possible conveniently to set this speed. The driving of the calender from the asynchronous motor with such a low speed hitherto presented considerable difficulties, and the object of this invention is to overcome them. A paper calender A is driven by an asynchronous motor B. When the paper is being drawn into the calender the stator winding of the motor B is disconnected from the supply circuit or mains and short circuited by means of the switch C. The rotor winding is connected to a series-wound commutator generator D with a driving motor E. F is a coupling that can be easily disconnected.—*November 3rd*, 1927.

279,912. December 22nd, 1926.—FEED-WATER REGULATORS, L. M. Bernon, 58, Westbourne-grove, London, W. 2, and R. J. Walker, Ormadale, Knighton Park-road, Leicester.

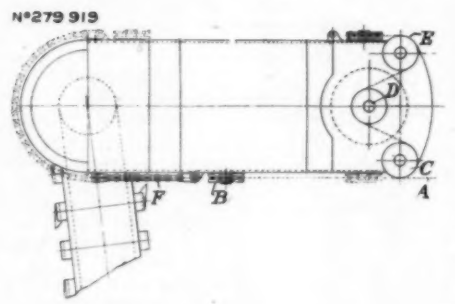
In this feed-control apparatus a double-beat valve A is arranged in the feed pipe, and is actuated by the double piston B B. The cylinder in which this piston works is connected with the float chamber C by means of piping indicated by dotted lines. The chamber communicates with the boiler at D. At



the top of the chamber there are two valves E E in the connecting pipes, which are operated by the float through the links and bell crank shown. The operation of the apparatus is obvious, but it should be pointed out that the pistons B B are not completely tight in the cylinder, so that if either one of the valves E E does not close tightly on its seat, the leakage past the corresponding piston will provide the unbalanced pressure necessary to actuate the valve A.—*November 10th*, 1927.

279,919. March 14th, 1927.—COAL-CUTTING MACHINES, F. W. Hurd, 70, Cunningham-park, Harrow.

The object of this invention is to provide a direct pull on the jib of a coal-cutting machine as near the face as is possible. The feed chain A is consequently led round the sheave B, over



the fair lead C, round the driving sprocket D and then over the second fair lead E. The sheave B is mounted on a slide to which the chain F is attached. This chain, it will be seen, is connected with the jib, so that the feeding pull is directly on the jib.—*November 10th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

CHEMICAL ENGINEERING GROUP.—Electricity Lecture Theatre of the University, Liverpool. Paper, "Oil Pollution of Seas and Harbours—and a Remedy," by Mr. C. S. Garland. 6 p.m. Visit to the ss. Adda at Liverpool Docks. 2.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Short papers by Messrs. G. C. R. Parker and R. C. Bond. 7 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: NORTH-EASTERN CENTRE, LEEDS AREA.—Hotel Metropole, Leeds. Paper, "Piston Gland Packing, and Coupling and Connecting-rod Lubrication," by Mr. C. F. Adams. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Some Experimental Results from a Three-cylinder Compound Locomotive," by Mr. Lawford H. Fry. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: NORTH-WESTERN DISTRICT.—Town Hall, Manchester. District meeting. 3 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, S.W. 1. Paper, "Chromium Plating and Modern Plating Practice," by Mr. E. J. Dobbs. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Hardening and Quenching Throughout the Ages," by Mr. P. J. Haler. 7.30 p.m.

POLYTECHNIC ENGINEERING SOCIETY.—309, Regent-street, London, W. 1. Annual conversazione. (Tickets obtainable from the Secretary.) 7.30 p.m.

SOCIETE DES INGENIEURS CIVILS DE FRANCE: BRITISH SECTION.—Institution of Civil Engineers, Great George-street, Westminster, London, S.W. 1. Paper, "The Port of Casablanca," by Monsieur Charles Laroche. 6 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Room 24, Royal Technical College, George-street, Glasgow. Paper, "The Turner Process of Low-temperature Carbonisation," by Mr. C. Turner. Cinema film, "The Manufacture of Tin-plate." 7 p.m.

SATURDAY, DECEMBER 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the Barking power station of the County of London Electric Supply Company. 2.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the testing and experimental station of David Kirkaldy and Son at Southwark, S.E.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. Papers: "Notes on an Inrush of Water at the Montagu Colliery, Scotswood, Northumberland, on March 30th, 1925," by Mr. H. T. Foster; "Impressions of the Canadian Empire Mining Congress," by Mr. W. Cochran Carr; and "Further Modifications of the Correlation of the Coal Seams of the Northumberland and Durham Coalfield," by Dr. W. Hopkins. 2.30 p.m.

MONDAY, DECEMBER 19TH.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. Lantern Lecture, "Rambles in Lakeland," by Mr. J. W. Shuttleworth. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Castle-street Hall, Luton. Luton Graduates' meeting. Exhibition of cinematograph films. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "The Technique of Gear Design," by Dr. H. E. Merritt. 7.30 p.m.

TUESDAY, DECEMBER 20TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Talk on Automobile Subjects, by Mr. L. H. Pomeroy. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Engineering and Scientific Club, Wolverhampton. Paper, "Military Transport Vehicles—Recent Developments and their Commercial Significance," by Captain C. H. Kuhne. 7.30 p.m.

WEDNESDAY, DECEMBER 21ST.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—Crystal Palace, London, S.E. 165th Award of Certificates. 3 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Paper, "Engine Cooling," by Mr. R. W. Buckler. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Literary and Philosophical Society's Rooms, 36, George-street, Manchester. Paper, "Notes on Sewage Works Design (Activated Sludge Process)," by Mr. W. H. G. Mercer. 6.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: MIDDLESBROUGH BRANCH GRADUATE SECTION.—Cleveland Scientific and Technical Institution, Middlesbrough. "The Progress in Diesel Design," by Mr. R. F. Battey. 7.30 p.m.

THURSDAY, DECEMBER 29TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Christmas Lecture, "Engines" (I.), by Professor E. N. Da C. Andrade. 3 p.m.

FRIDAY, DECEMBER 30TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "The Burmese Lacquer Industry," by Mr. A. P. Morris. 7.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

ROBERT HEATH AND LOW MOOR, Ltd., of Low Moor Ironworks, Bradford, Yorkshire, ask us to announce that Mr. W. Vincent Waite, M.I. Mech. E., A.M.I.E.E., has been appointed general works manager at their Low Moor Works.

MESSRS. GRIER AND CO., of 32, Gt. St. Helens, London, E.C. 3, ask us to announce that they have been appointed sole representatives for the United Kingdom, Ireland and British Dominions of the "De Maas" Shipbuilding Company, of Slikkerveer, Holland.

W. F. DENNIS AND CO., of 70, Queen Victoria-street, London, E.C. 4, ask us to announce that they have been appointed sole representatives in Great Britain, Northern Ireland and the Irish Free State, for the Heckel Company, Ltd., Saarbrucken, Saar (Territory of the).

LOUDON BROTHERS, Ltd., of 26, Bothwell-street, Glasgow, Johnstone and London, ask us to announce that on account of ill-health Mr. James T. Stuart has resigned the positions of chairman and director of the company, with which he had been associated for over fifty years.

CONCERNING the announcement that was made in several of the newspapers recently that an international "ring" of cast iron pipe makers had been brought into operation, covering America, England, France and Germany, and that the Stanton Ironworks Company, Ltd., was the British firm in that "ring," that company desires us to announce that it emphatically denies any suggestion of any financial arrangement with regard to capital, or with regard to selling prices, with producers either at home or abroad.

CALENDARS, DIARIES, &c.

JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, U.S.A., and L. G. Sloan, Ltd., 41, Kingsway, London, W.C. 2.—A case of Elderado drawing pencils of varying hardness, and another containing an assortment of Dixon's "Best" coloured pencils. The range of colours is remarkable, and all the pencils work pleasantly under the hand.

THE IRONMONGER DIARY AND HARDWARE BUYERS' GUIDE 1928, 42, Cannon-street, E.C. 4, contains, besides many pages of diary, quarto size, a number of very useful tables covering prices, weights and sizes, &c., of various goods handled by ironmongers, but is principally devoted to numerous pages of display advertisements, making it a very useful book of reference for the trade.

THE FOURTH MACHINE TOOL AND ENGINEERING EXHIBITION.—The fourth Machine Tool and Engineering Exhibition is to be held at Olympia from September 5th to 22nd next year. We understand that already the whole of the main hall and nearly the whole of the annexe has been booked by exhibitors, and that a considerable part of the gallery is also let.